THE AMERICAN JOURNAL OF ROENTGENOLOGY
RADIUM THERAPY AND NUCLEAR MEDICINE

VOL. 68 OCTOBER, 1952 No. 4

THE PLACE OF THE AMERICAN RADIUM SOCIETY IN THE PROGRESS OF MODERN MEDICINE*

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THE American Radium Society is now thirty-five years old—a little more than a third of a century.

In this short period, many events have occurred and many pronouncements have been made in this Society's history that stand out as guideposts, chapters, or milestones of progress in modern medicine.

In this report, I wish to mention some of these chapters or periods of progress, some of the progress issues of today, and, in retrospect, allude to some of the important individuals, together with their achievements, who have played an outstanding part in the early or formative period of this Society's history. Time will not permit me in this review to give special mention, honor, or justice to the many in this country and abroad, whose works down through the years have left their contributing influences in the annals and achievements in this Society.

No one can chart the course or navigate the future without a knowledge of the past. It is upon the past events that all progress has been and will be made.

In any account, report, or review on progress in this Society, one must first look beyond its organization to the foundation period which gave it birth and mention some of the unique circumstances and persons involved which have had their effects and left their imprint in this Society's history and progress.

All great periods in history seem to depend on past great periods in history in one way or another for their being, influence, accomplishments and achievements.

The year 1895 brought the discovery of the x-ray by Wilhelm Konrad Röntgen and this was followed shortly by the work leading to the discovery of radioactivity by Henry Becquerel, who, by experimenting with uranium compounds, proved that rays similar in effect to roentgen rays were spontaneously and continuously emitted from all uranium compounds, and that these were a specific property of the uranium atom. This stimulated and led to the further investigation of these radiations by Mme. Curie to find out whether other substances besides uranium produced the

* President's Address delivered before the Thirty-third Annual Meeting, American Radium Society, Atlantic City, N. J., June 7–9, 1951.

same phenomena. All the then known elements were studied and it was found that only uranium and thorium produced these radiations. Certain minerals and ores were also studied, and it was found by her investigations that certain of these containing uranium produced radiations or activity of much greater intensity than could be accounted for by the amount or content of the uranium therein contained; and she concluded that a heretofore unknown element must be present. By close collaboration with her husband, Pierre Curie, a noted scientist and physicist, the then known over-radioactive ore, pitchblende, was analyzed as to its composition by both chemical and ionizing methods, and in July, 1898, it was announced that a new increased radioactive element had been discovered, which Mme. Curie named polonium after her native land, Poland; and in December of the same year a much greater or increased radioactive element was discovered which they named radium. From the effect of an accidental burn which Becquerel received on his skin from carrying a tube of radium in his vest pocket, and by the subsequent experimental productions of the same biologic effects by Pierre Curie, it was not long before this agent was recognized as a possible useful therapeutic aid in the treatment of disease. In 1899, Rutherford identified the alpha and beta particles of radium, which finally led to the disclosure of the structure of the atom and the existence of the nucleus of the atom.

These discoveries marked a most important milestone in the progress of science and medicine.

It seems incredible to think that out of these discoveries should come, in so short a time as little over half a century, such far reaching achievements in atomic energy research and fission effects as to hold human destiny in its hands or to modify or change the economic, social and political life of man, and to offer to the medical world, as well, tools—the importance of which seem as yet merely in the making.

It would seem fitting at this time to pay honor and respect to these forefathers of radiation therapy, who by their courage and fortitude passed through many discouragements and hardships little known to most of us, but upon whose discoveries and achievements human thought so much now centers.

"This was the period of discovery."

These discoveries and their recognized biological effects as possible important useful agents in the treatment of disease prompted and are the principles on which this Society was organized in the year 1916—eighteen years after the discovery of radium. There is but one remaining charter member left, Dr. James T. Case, now of Santa Barbara, California.

Its original constitution clearly sets forth its aims and objectives, and I quote, "To promote the scientific study of radium in relation to its physical properties and its therapeutic application."

By the adoption of this constitution was laid the future course of a new society that was to take its place in the thinking and accomplishments of modern medicine.

From the very beginning, the major interests of this Society have been in the field of cancer and allied diseases in various phases of investigation and treatment; at first especially in the field of radium research and radium therapy and later to be expanded or to embrace all fields interested in the investigation, study, and treatment of cancer.

While radium had been used in the treatment of cancer in Continental Europe and England, it was Dr. Robert Abbe of New York, a member of this Society, who first applied its use in the treatment of cancer in America in March, 1905.

Although there were many contemporaries interested in the study and treatment of cancer in one branch or another, it remained for that great character of this period, Dr. James Ewing of New York, an honorary member of this Society, to dominate with dynamic force the importance of the cancer hospital. Dr. Ewing stands out as the father, pioneer, and foremost investigator in America in the entire

field of cancer. His ideas and conceptions that cancer and allied diseases are a "specialized branch of medicine and should be investigated and treated in all its many and related phases as such" represent with ever increasing importance this vision and thinking as a unique advance or milestone of progress in modern medicine and in the history and progress of this Society. In this period, all in this country looked for knowledge, inspiration and guidance to the old Memorial Hospital, fathered, fostered and dominated by Dr. James Ewing.

The many pronouncements that have come forth from this hospital under this genius in "pathology, radium therapy, and radiation physics" stand out as guideposts along the highway of progress in modern cancer therapy. Here was a unique man, to all who knew him; one possessed with an unwavering loyalty, devotion and conviction to ideals and ideas, and one of the noted pathologists of all time, especially in the field of cancer; an eminent teacher, investigator and clinician—all combined in one. It was in his time and under his dominant influence that radium and radiation therapy gained its greatest stimulus, impetus and advance in this country. It is probably because of his persistent interest and influence in radium and radiation therapy that many of the guiding lessons and many of the pitfalls of radium and radiation therapy are known so well to all of us.

Few will look back without saying that Dr. James Ewing was one of the outstanding scholars and contributors of medical thought and achievements in the past century and one of the foremost cancerologists of all time.

Another contemporary character of the same period, whom we honor in this Society each year, was Dr. Henry Harrington Janeway, surgeon, pioneer, and conqueror in a new and uncharted field of medicine—a man of vision, observation, imagination and truly great accomplishments. Janeway early appreciated the necessity and importance of radiation physics to apply successfully the use of radium as a therapeutic agent in the treatment of cancer. He himself became a student of radiation physics. It was in his time that the real birth of radiation physics came into being.

It is rather unique that a society should be organized on such principles or objectives: (1) based on the discovery of radium; (2) founded on new and revolutionary principles and concepts of therapy; and (3) dependent in its formative period and largely on its future existence on the physicist for controlling and harnessing dangerous and destructive physical agents, so that these could be safely, scientifically and effectively applied in the treatment of cancer.

Ewing, Janeway, Quick, Failla, and Quimby—all members of this Society—stand out as the unique contemporary characters in America in the many phases of the accomplishments of this early period. This was the formative or evolutionary period of radium therapy or the transformation period from empiricism or trial and error to the development of radium into an art and a science. This was the foundation period or framework on which all radiation therapy was to build and progress. In this formative period and the great developmental period that followed were molded together among surgeon, radiologist, radiation physicist, pathologist and clinician a unified interest and diversified thought, the integrated accomplishments of which changed the thinking and course of cancer therapy and as such remains the foundation of modern cancer therapy.

Out of this period came the knowledge or mode of action of radiation upon cancer tissues, the accuracy and measurement of tissue dosage and dosage rate and their related tissue biologic effects, the study of radium filters for surface and body cavities with the standardization of filters and the establishment of doses. In this period came the evolutionary steps or principles in interstitial radium therapy. Dominici seems to have been the first to employ interstitial irradiation by the use of a buried radium tube; a method later to be improved upon by the interstitial use of low content radium

element needles by the Curie Institute of Paris. In America, radium emanation was instituted for interstitial use by Janeway at the Memorial Hospital in 1916 by employing unfiltered glass radon seeds. These were replaced as a step forward in progress by Failla in 1924 by substituting gold filtered capillary radon seeds in the place of glass. This form of radiation therapy has remained a very important, useful and versatile type of treatment in the many complex and complicating problems in cancer therapy. From this period came the knowledge and the importance of the natural history of tumors—that pathological grounds are the basis for appraisal and selection for cancer treatment methods used. In this period came the histopathological grouping of tumors on the basis of cellular differentiation and the knowledge or related principles of radiosensitivity and radioresistance of tumors, or that all tumors do not respond the same biologically to like or equal amounts of radiation.

In this period came the need and necessity for roentgen radiation to take the place of the limited available supplies of radium, out of which has come the tremendous development in the many technical devices and apparatus to produce higher voltages with greater depth doses, all with the aim by ways and means to produce rays comparable in effect to the gamma rays of radium. In this period were developed the standardization or unit of roentgen-ray dose in terms of the roentgen, and the unit dose of radium in terms of the gamma roentgen, and the establishment of dosage applications in terms of tumor roentgens or tumor gamma roentgens. This developmental period, in many ways, clarified or correlated the limitations, choices and methods of the various treatment agents used, all with the summation that surgery and radiation methods are not competitive agents, but are complementary, one to the other, in their time and place as being the most useful in the treatment of the cancer patient.

These are some of the many evolutionary steps of progress within the lifetime of this Society. Many are original contributions from its own membership, some are elaborations or additions to, and many are the original works or additions of those beyond this membership in this country and abroad—all of which, however, have entered into the composite progress picture of modern cancer therapy.

"This was the formative and developmental period in modern cancer therapy."

The pendulum has swung back and forth many times over the years. Each year has brought new thoughts, new discoveries, new issues, new problems, new necessities and contending controversies, out of which have crystallized many facts and truths ever to be subject to change or modification as each succeeding fact or truth becomes established.

The cancer process, however, remains unchanged, still far from known, still unconquered, with as yet no specific form or forms of treatment.

Little wonder that such shiftings should occur in the thinking approaches and conclusions, and that these should continue to change or be modified until the known or more exact knowledge of the known becomes discovered.

Probably no greater accomplishments have occurred in any branch of all medicine than in the field of cancer, and probably no field where more opinions and controversies and unsettled states or problems still remain unanswered.

The World War II years and the post-War period brought many changes in cancer therapy. With the advent of and release during and after the war of antibiotics, chemotherapy, with the improvements in the many problems of anesthesia, with the improvements in the technical advances in vascular surgery, with a better knowledge and understanding of pathological physiology and improved postoperative treatment care, and the establishment of the blood bank, many previously tried and discarded surgical procedures became again evident as now safe and within the reach of extended and far greater possibilities, the magnitude and growth of which at times defies the imagination.

There are other reasons or theories upon

which many of these new and extended surgical trends, developments or advances are also based: (1) some are based on the proved facts that radiation has little or no place in the treatment of certain types of tumors; (2) some are based on the theory that radiation has reached, in certain tumors or in certain stages of certain tumors, a fixed plateau where further improvement in curative or palliative results seems in question; and (3) some are based on the contention that these surgical advances are improved palliative and pain relieving measures in the radiation fast or radiation failure cases.

"This is the period of surgical revival and change."

These inclusions into the cancer treatment problem of today call or will call for a re-evaluation or re-assessment of many of the current cancer issues both in the field of surgery and radiation therapy which obviously may produce some alterations, some modifications and some changes in the choice and place of these two methods of treatment. These new surgical procedures are important challenging issues of progress in cancer therapy and should be encouraged, but attempted only by those well trained and equipped to handle such problems.

Change does not always mean improvement or progress, however. All changes are open to question and might be subject to many subsequent revisions—important minor, major or radical changes, or even reversals at any time before the final answers are forthcoming. These are recognizable facts we must all accept. This has been the history of the past and undoubtedly will be so in the future. In the past thirty years of observation, I have seen many changes, modifications, retractions and revivals—all with the summation that "time" seems to be the greatest factor, stabilizer and appraiser of the truth in all the many issues and contending controversies.

Now I have no personal controversy in these many present issues and changes. I am of the same opinion that all of you are—that we are all seeking the truth; that we in this Society are interested in and recognize all the established methods of the treatment of cancer, choosing as such one modality over the other only as the one, in its proper time and place, seems to take precedence over the other as proving more useful.

It would seem that many of these recent surgical trends are now well established as important major advances, achievements and challenging procedures as increased curative, improved palliative and pain relieving measures. Many of these surgical procedures, however, would seem such as must be tempered with caution and more time and on a more careful appraisal of the accomplishments and records of the past to justify or justly appraise them correctly.

I hope that I can share with you a certain liberalism of thought and opinion in these many problems and issues that for the moment seem to be in this unsettled state or change, and await the final outcome of these differences and controversies based on sound comparative statistical studies of their many varied and related phases.

It is only by a comparative absolute cure rate statistical study that we can hope to arrive at an adequate appraisal of the various treatment methods used. On either side, the mere hypothesis or personal views and conclusions and opinions of the results of any form of treatment would seem somewhat little more than meaningless.

There are many things to consider as progress in treatment, however. The mere comparison of absolute cure rate statistical studies in the various forms of therapy used is one thing as far as cure rate is concerned, but is not necessarily all inclusive in the summation of the best form or forms of treatment for the cancer patient, without, in addition, a fair appraisal of the many contributing aspects of individual comfort to the patient in numbers of livable weeks, months or years, the best economic preservation to the patient, the best functional or cosmetic results obtained or preserved, and the best possible position for the patient and his family to take their

normal places in society.

A patient may live longer with one form of treatment than with another, but to himself and others, does he live a happier and more useful life? Ofttimes the human side of values becomes forgotten in an effort to view everything on an absolute or critical cure rate statistical study.

One may state that such conclusions can only be based on theory or the misconception of altruism, but even so it might seem many times that these are issues for much consideration, concern and speculation in the care of any given cancer patient, and might well be appraising factors in the light of what we call the evolution or progress in any treatment method or procedure.

I can see one possible danger in the outgrowth of these wartime and post-wartime changes that many of the older ones in this Society might look upon as I do with a certain regret and concern; not because of these surgical views and changes or that radiation methods are being modified or replaced in some important ways, but largely because the knowledge and application of sound scientific radiation therapy would appear to be coming inadvertently lost as an art and a science to the many throughout the country who are now being trained as the cancer specialists—mainly in surgical methods and who are to take their places among the students of thought and leaders in the cancer world of tomorrow.

In many ways, this might seem to represent a sad commentary on the radiation accomplishments of the past and on the thinking of the present in the training of the student, the resident, and the coming cancer specialist. Radiation methods of treatment represent just as much an art and a science as sound surgical procedures do. The accuracy, choice and methods of radiation application are just as important as the choice, skill and technique of any surgical procedures, and both still have their time and place in the best care and treatment of the cancer patient.

It seems apparent that there is a growing need for further adequate education of medical student, resident, and those now training as the cancer specialist in the best uses, methods and application of radium and radiation therapy in all their many aspects. To be all inclusive in this respect for either trained cancer specialist or radiologist, it would seem to require a broad and inclusive knowledge of anatomy, pathology, radiation physics, the biologic effects of radiation, the natural history or course of tumors and a knowledge of sound surgical principles. All these would appear to be important in the academic training of the medical student as well as to be projected into the training of the radiologist and cancer specialist.

Radium, while now limited in its usage, still remains an indispensable useful agent in the many problems of cancer and allied diseases and yet a dangerous and destructive agent in the untrained and incompetent hands of the many now using it.

A special committee of this Society, at the request of the Board of Chancellors of the American College of Radiology, has now made important contributions in the usage of radium by formulating desirable standards of qualifications to permit physicians to apply radium in hospitals. This could be a valuable step forward, if carried into action, as a protection against the abuses of a useful cancer agent which is so sadly and unfortunately used and misapplied by so many in practice. It seems fitting that this Society, the only one with stated objectives as to the study and uses of radium, should or might occupy a more important place in the stimulation, guidance, thinking and training in the medical school, the hospital, and the profession at large as to radium's place of usefulness and as to its modes and methods of scientific application.

Another avenue for progress in this Society in the way of education and training has been in the formulating, elevating, and protection of standards in radium therapy by its cooperation in the activities of the American Board of Radiology. In this council of thought and appraisal of applicants is the opportunity for controlling all forms of radiation therapy in keeping

with the standards of high ethical conduct and accepted scientific methods of sound radiation practices.

Last year this Society adopted a new constitution embracing and enlarging on its original principles or objectives, and I quote: "The object of this Society is to promote the scientific study of radium and other sources of ionizing radiation in relation to their physical properties and their therapeutic application." This would seem another step forward in progress. By adopting this constitution, this Society becomes an ever increasing avenue of exchange in the many and varied aspects of the cancer problem. I know of no society where greater potential opportunities and possibilities for progress exists than in this one, so constituted with its membership of surgeons, radiologists and scientists—all interested in the common problems of cancer. This is the only society so organized for the study and investigation of the cancer problem from every conceivable angle of approach with all the specialties involved.

The years of World War II and the post-War period have brought other changes in the treatment of cancer besides those in the field of surgery and radiation therapy in the way of new informative researches. The increased pathways of exchange and investigation in these new researches have produced a tempo of thought filled with ideas almost to cloud the imagination. What the future holds in way of progress, no one can predict and probably little dream of. The horizon is aflame with new concepts, problems, and issues of investigations in ways of numerous chemical compounds, radioisotopes, and steroid hormone metaboloids—the correlation of the advances and accomplishments of which may well change completely many heretofore established principles of therapy and produce a solution of the complex and at present unsolved confused and disturbing problems.

This may or may not be in our time, but the evidence points to a broad highway of investigation in many fields, the accomplishment of which will sooner or later have their influence and take their place as challenging procedures in the field of cancer therapy, but which, as yet, except in some examples already established, are not inclusive as major threats or accepted as competing stable therapeutic agents in the cure of the cancer patient. While the accomplishments of these studies and adventures are mainly fragmentary and uncertain and mostly palliative in nature at this particular time, the leads are promising and may well be within reach of a solution of many of the perplexing questions at any time.

"This is the pronouncement period of new research."

In this evolution of new research and investigation, one can but conjecture. It would seem to be dangerous, however, for overoptimism to overshadow the picture of sheer practicability, as a newness of thought and immature evidences of facts not yet proved ofttimes seem to do.

We may be of different opinions, and the controversial issues may seem wide apart, and rightly this should be, for this is the essence of progress. In the last analysis, however, we all stand on one common ground and with but one common purpose or objective in mind—that of the saving of human life and the alleviating of human suffering, no matter what method or methods seem most clearly to accomplish these objectives.

In all these present unsettled and controversial states in a field still unconquered, this would seem to be a time, as always, for unbiased interest, vision, and clear and independent thinking, mellowed with an abundance of patience, tolerance, understanding, and sound and cautious judgment.

In conclusion, I would like to leave one thought with you which seems to me is a fundamental principle of progress expressed by the learned scholar and poet, Ralph Waldo Emerson: "We are of different opinions at different hours, but we may always be said to be at heart on the side of truth."

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DISCOGRAPHY

TECHNIQUE, INDICATIONS AND EVALUATION OF THE NORMAL AND ABNORMAL INTERVERTEBRAL DISC

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THE profound interest of the medical profession in the anatomy and physiology of the intervertebral disc can be attributed to the early work of Schmorl[14] who described and demonstrated herniation of the nucleus pulposus into the vertebral body—the lesion which bears his name. Schmorl's contribution stimulated experimental and anatomical investigation on the function of the intervertebral disc, the most thorough of which was made by Keyes and Compere[8] (1932). Then follows the valuable contribution of Mixter and Barr[11] (1934) who correlated injuries of the intervertebral disc with the age old symptoms of low back pain associated with sciatica. A pathological etiology for this syndrome was thus established. A tremendous volume of literature on intervertebral disc injuries has accumulated since 1937, indicating the frequency, interest and clinical importance of this lesion. The literature, however, has been particularly concerned with the pathology, the surgical treatment of the ruptured disc and results of treatment. Comparatively little has been published on the roentgenographic diagnosis. A few early articles on myelography with lipiodol demonstrated herniation of the ruptured disc into the spinal canal.[2,7] Later, similar evidence was revealed by pantopaque.[1,4] Relatively few articles have appeared on the indirect roentgenographic evidence of injury to the intervertebral disc manifested by secondary structural changes in the vertebrae. It is the purpose of this communication to describe and illustrate the roentgenographic evidence of injuries to the intervertebral disc by the discogram and to compare the normal with the abnormal.

Discography was first described in 1950 by Lindblom,[10] a radiologist of Stockholm, Sweden. Lindblom was distressed by the unreliability and inconsistency of myelography in the demonstration of ruptured intervertebral disc. Not infrequently, in patients presenting a classical clinical syndrome of a herniated disc, subsequently verified at surgery, the preoperative myelogram is considered negative. Frequently a herniated disc diagnosed by myelography is not substantiated at operation. Scoville *et al.*[12] could confirm by operation only 131 out of 196 positive myelograms. Ford and Key[5] reported correct myelographic diagnosis in only 72.3 per cent of their 253 cases. Lindblom conceived the method of demonstrating the nucleus pulposus, roentgenographically by direct puncture of the disc through the spinal canal by injecting contrast material with a long fine needle. This method, disclosing roentgenographically the interior pathological anatomy of an injured disc, has partially revolutionalized our concept of the etiology and treatment of low back pain. As a *diagnostic procedure*, it provides more comprehensive information than the myelogram and is utilized instead of myelography for many suspected lumbar disc lesions. Those who have had sufficient experience with the discography in the past year (Gardner *et al.*[6] and Wolkin[15]) are of the same opinion.

INDICATIONS AND CONTRAINDICATIONS

The procedure of discography is reserved for those patients in whom a ruptured disc is strongly suspected from the history of back injury followed by repeated attacks of disabling low back pain. If the

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patient has pain in one or both of the lower extremities, along the distribution of the sciatic nerve, and has neurological signs of nerve root compression, we prefer to localize the level of the ruptured disc by myelography. These symptoms indicate a protrusion or herniation of the ruptured disc into the spinal canal which can be visualized by an intraspinal opaque medium. If the myelogram in such a case appears normal, discography is then performed. We have felt that intraspinal protrusion of the disc, frequently accompanied by a defect in the posterior fibers of the annulus fibrosus, is a contraindication to discography. The reasons are two-fold. First, a unilateral herniation of the disc may displace the roots of the cauda equina toward the midline or may cause marked swelling and engorgement of the single nerve root involved. The passage of the needle through the dural sac in these cases is likely to make contact with roots of the cauda equina causing the patient pain during the procedure or possibly damaging the nerve roots. Second, if a rent in the posterior fibers of the annulus fibrosus is present, the diodrast injected into the intervertebral space will escape through the opening posteriorly into the spinal canal (Fig. 9*B*). This epidural injection of diodrast may cause root pain which persists for five to ten minutes following the procedure.

The indications for and the chief value of discography lie in the ability to recognize the presence of a ruptured disc as a cause of the patient's complaints of back pain following trauma without herniation of the disc into the spinal canal and without pressure on the nerve roots. In addition to the patient's history, roentgen evidence of changes in the vertebrae at the level of the suspected lesion is also indication for discography. If the intervertebral space is narrowed with or without an associated localized chronic hypertrophic spondylosteitis (marginal spur formation) a suspected rupture of the disc can be verified by this procedure.

TECHNIQUE

The patient is hospitalized and prepared an hour before discography with nembutal gr. III (gm. 0.2) and morphine sulfate gr. $\frac{1}{4}$ (gm. 0.13). Discography is sometimes painful, so that adequate preparation with an analgesic is necessary. The patient is placed on his side on the roentgenographic table in the flexed position (knees drawn up under the chin) for a lumbar puncture. A true lateral roentgenogram of the lumbosacral spine is desirable. We have found that this can be obtained by placing a fairly large noncompressible, nonopaque pad under the lower costal margin, which elevates the thoracic cage level with the hip and positions the lumbar spine parallel with the table top (Fig. 1). The lumbar area is prepared with antiseptic solutions, and sterile drapes, and the skin over the spaces of L3–4, L4–5 also L5–S1 is infiltrated with 1 per cent novocain solution. The full length of a No. 19 needle ($1\frac{1}{2}$ inches) is inserted in the midline, between L4–5 and another between L5–S1. A lateral roentgenogram is obtained to determine if the direction of the needles is in the same plane with the center of the intervertebral space. When the short needle is properly directed, a fine No. 22 or No. 24 spinal needle, 4 inches long, is inserted into the No. 19 needle, gently pushed through the ligamentum flavum and posterior dura and into the spinal canal. A specimen of cerebrospinal fluid is obtained. The needle is then advanced to the anterior dura. The patient will usually complain of sharp back pain when the needle comes in contact with the anterior dura. Pain felt in the lower extremities indicates that the needle is not directly in the center of the spinal canal, and must be adjusted. The nerve roots of the cauda equina which normally lie laterally in the dural sac are usually not touched by the needle if the puncture is made in the midline. If a nerve root is irritated, the patient will experience pain radiating into the lower extremity or buttocks. When the patient complains of back pain only, the needle is forced forward. If the disc is entered there is a slight resistance as it passes into the annulus fibrosus and then a "give" as it enters the nucleus pulposus. If the patient feels the pain attributed to anterior dural irritation and the needle cannot be advanced, the intervertebral space has been missed and the needle is in contact with the vertebral body. A roentgenogram will indicate

whether the needle must be directed cephalad or caudad to enter the interspace. After the long needles are in place, it is advisable to check again by a roentgenogram to determine the exact location of the needle point. It should be in the center of the nucleus pulposus, *i.e.*, at the junction of the posterior and middle third of the interspace and in the mid-vertical plane (Fig. 3*A*). It may be necessary to withdraw the needle slightly or insert it deeper before the injection is made.

Injection of the opaque material (35 per cent diodrast) is often quite painful. The patient describes the pain as a bursting sensation located deep in the middle of the spine. Frequently, the patient will volunteer the information that the pain in the back induced by the injection is similar to that which he experiences in bending, lifting, etc. The pain may be reduced considerably by injecting 0.5 cc. of 1 per cent novocain slowly into the disc three minutes before instillation of the contrast solution. Using a 10 cc. Luer-Lok syringe, the diodrast is forced into the nucleus through the fine needle. A normal disc will take from 0.5 to 1 cc. of the solution. Considerable pressure is often necessary to force this amount of contrast medium into the disc, and the patient may complain of pain. If the syringe is immediately removed from the needle, the positive pressure within the nucleus pulposus will often force the diodrast back in a spurting stream. It is advisable, therefore, to leave the syringe attached and to apply pressure gently to the plunger for thirty seconds to one minute to permit diffusion of the opaque material through the nucleus pulposus.

If the disc is ruptured or degenerated, 2 to 5 cc. (or more) of diodrast can be injected, with ease, requiring little pressure on the syringe. The patient may not complain of pain with the abnormal disc until 3 to 5 cc. has been injected. If the interspace is filled with the fluid under pressure, and a portion of the

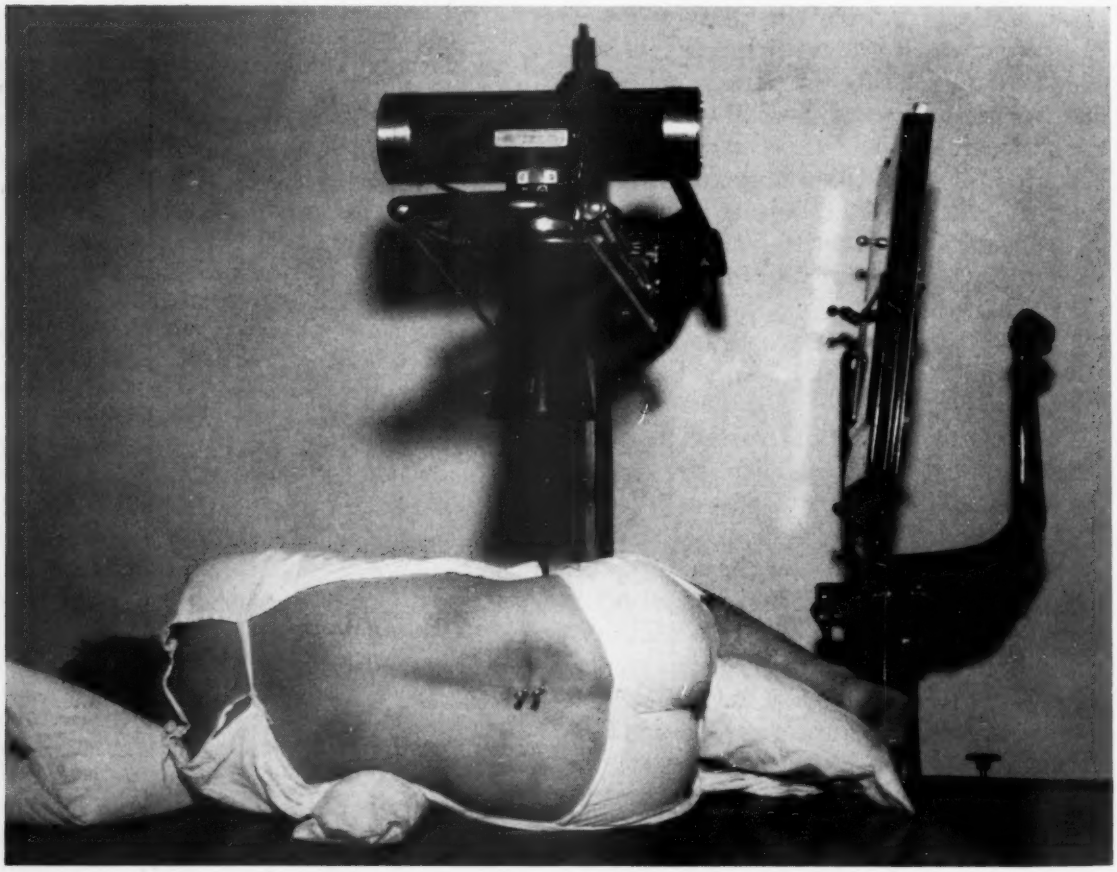

Fig. 1. Position for discography—insertion of needles and lateral roentgenograms. Note pad under rib margin to straighten lumbar spine for true lateral film.

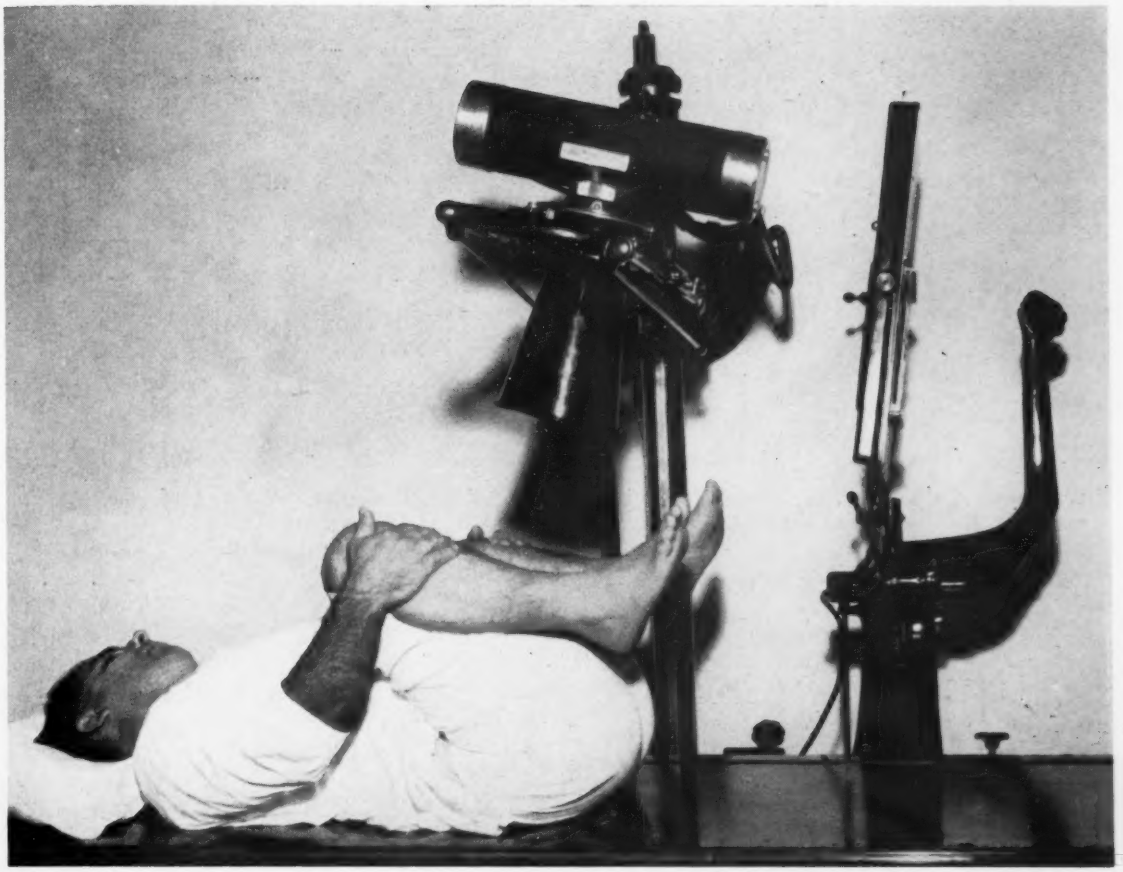

Fig. 2. Position for anteroposterior roentgenogram to best demonstrate lumbosacral and L4-5 interspaces. Knees are held wide apart by patient, tube tilted cephalad 10° to 15°.

ruptured disc protrudes into the spinal canal, compressing a nerve root, the increased pressure within the disc may be transmitted to the nerve root, reproducing the patient's sciatic pain. If there is a traumatic tear in the posterior fibers of the annulus fibrosus, the diodrast may escape into the spinal canal, causing pain in the lower extremities as well as the back (Fig. 9*B*). The discomfort which the patient experiences, however, is only of short duration.

Occasional severe pain at the time of injection will subside completely before the procedure is terminated and the films have been developed.

When the two discs have been injected the syringe is removed, and lateral roentgenograms obtained, developed and examined. If the roentgenogram demonstrates a normal disc at each of the two levels, and a ruptured disc is strongly suspected, clinically, then a third injection is made between L3–4 and roentgenograms taken (Fig. 3*C* and *D*).

The needles are then removed, dressing applied and the patient turned on his back. The knees are hyperflexed on the abdomen and thighs abducted. The roentgen tube is tilted in the plane with the lumbosacral articulation (from 10° to 20° toward the head) and anteroposterior stereoscopic roentgenograms are obtained (Fig. 2). The patient is then placed in the standing position and lateral films obtained to visualize the abnormal disc during weight bearing. The entire procedure, including the development of the films, requires approximately thirty minutes to perform.

Discography has demonstrated information about the physiology of the intervertebral disc which was previously not known. Because of its fibrous nature and its very limited blood supply it was always assumed that the disc had a very low metabolism, *i.e.*, the interchange of fluids was limited and took place at a slow rate. The diodrast has been shown to disappear completely from the intervertebral space with-

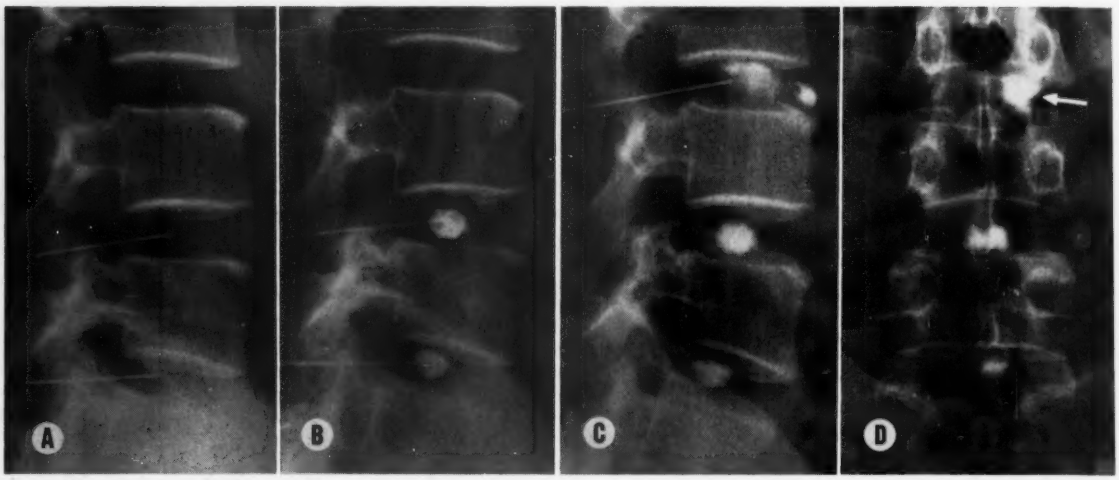

Fig. 3. Normal discogram (L_{4-5} and L_5-S_1) illustrating position of needles in intervertebral space. Only nucleus pulposus demonstrated by diodrast. (*A*) and (*B*) Anterolateral rupture of L_{3-4} disc demonstrated when distal two discs were found to be normal. (*C*) and (*D*) Patient had severe back pain with marked muscle spasm and list to right following an injury. There was no sciatica.

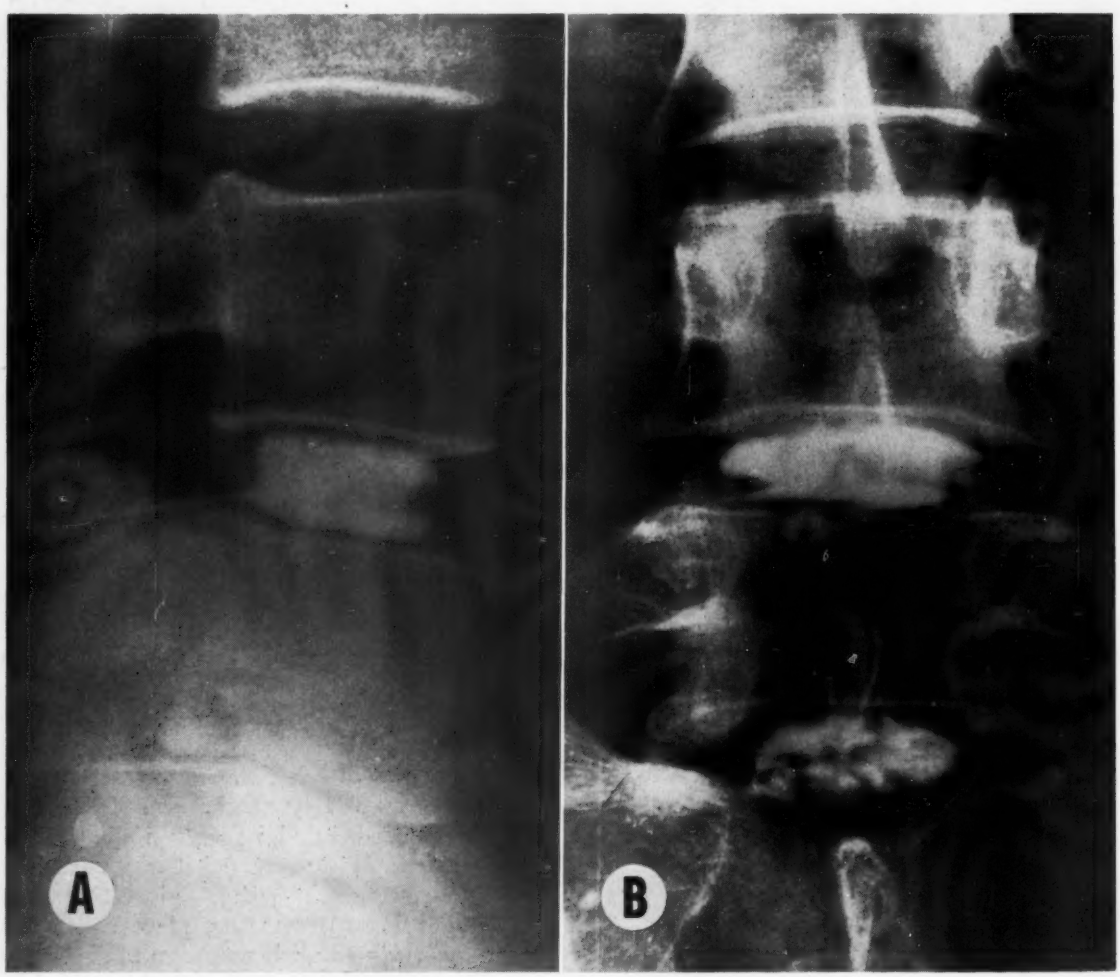

Fig. 4. Normal discogram with unusually large rectangular nucleus pulposus at L_{4-5}. The lumbosacral nucleus is oval shaped.

in twenty minutes after the injection, so that it cannot be seen roentgenographically. This indicates a very rapid fluid exchange in the disc. This absorptive rate varies in different patients, probably in proportion to the general hydration of the body. In some patients it is so rapid, if too much time is consumed in the procedure (developing films, etc.), the opaque material may not be well seen when the anteroposterior roentgenograms are taken. In other patients, the absorption may be delayed for an hour. The diodrast disappears more rapidly from the normal than the ruptured disc, as a rule.

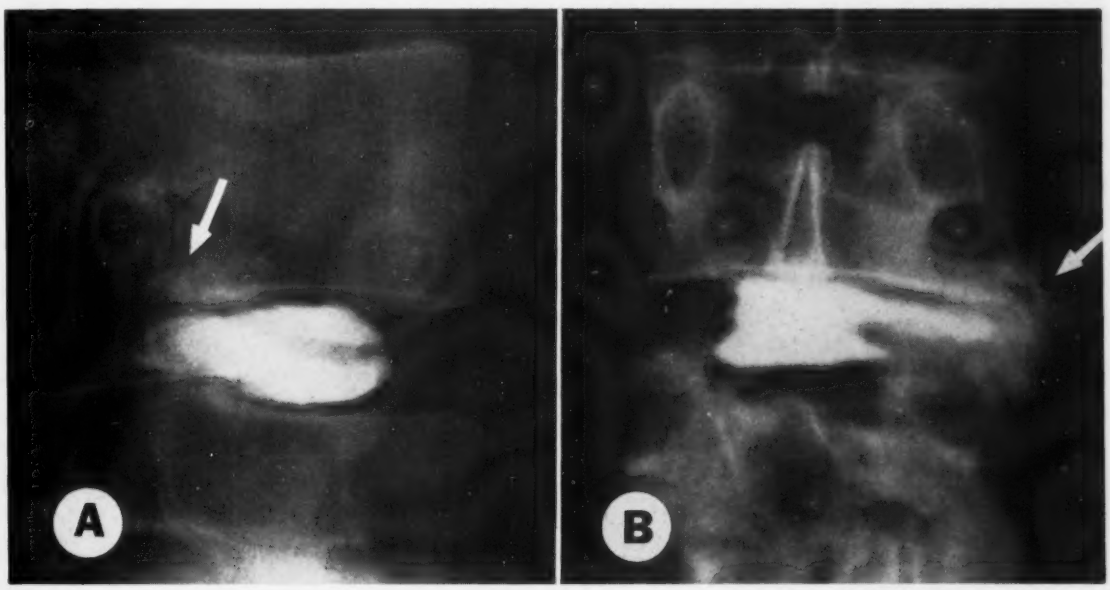

Fig. 5. Posterolateral herniation of L4-5 disc. Note torn fibers of annulus fibrosus posterior to nucleus pulposus filled with diodrast (*A*) and extending beneath the lateral intervertebral ligament (arrow). The intervertebral space is slightly narrower on the side of the herniation (*B*).

THE NORMAL DISC

When a normal disc is suspected from the injection (less than 1 cc.), the roentgenogram will disclose the diodrast confined to the region of the nucleus pulposus (Fig. 3*B*). If there is no rupture, tear or rent in the annulus fibrosus or the cartilaginous plates, the opaque solution will diffuse through the fluid part of the disc only. In the lateral view, the intact annulus can be seen anterior and posterior to the disc; the anterior portion of annulus is is twice as deep as the posterior portion. The superior and inferior confines of the nucleus are the cartilaginous plates which appear as a thin dark line between the cortical surface of the vertebral body and the opacified nucleus (Fig. 4*A*).

The shape of the normal nucleus pulposus is variable. It is best demonstrated in the lateral projection and appears as a slightly oval mass, often with a radiolucent horizontal band through its center (Fig. 6*A*). A long oval nucleus (Fig. 4) is generally observed in the lumbosacral disc whereas the L4–5 or L3–4 discs frequently present a round or square contour. Square or rectangular (Fig. 4) and perfectly round (Fig. 3*B*) and cup-shaped (Fig. 10*A*) nuclei are occasionally encountered. In the anteroposterior view the normal nucleus is either round (Fig. 3*D*), oval (Fig. 4*B*) or collar-button in shape, as a figure 8 flattened on the upper and lower end (Fig. 6*B*). The exact nature of the hour-glass constriction of the nuclear material has not been determined. The normal disc shows a wide symmetrical space containing no contrast medium on either side of the opaque nucleus which represents the intact annulus fibrosus.

The size of the normal nuclei is also

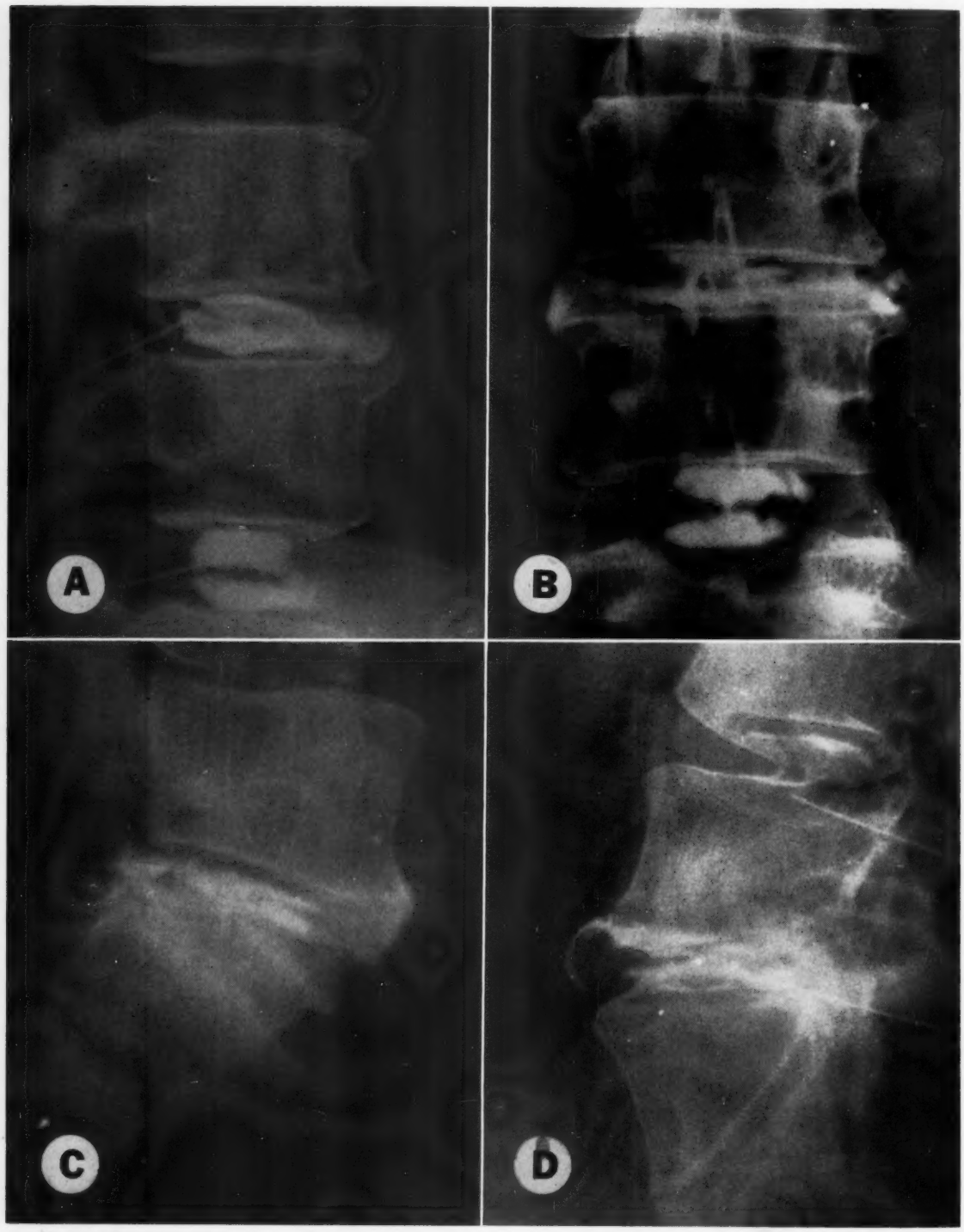

Fig. 6. Anterior herniations of disc. (*A*) Large osteophyte on anterior margin of body of L-3 and L-4 follow contour of anterior protrusion of disc. (*B*) Diodrast extends beyond confines of intervertebral space both anteriorly and laterally. Normal figure 8 nucleus at L4-5. (*C*) Complete rupture of disc with anterior rupture beneath anterior longitudinal ligament. (*D*) Thin line of diodrast outlining a large sequestrated fragment of disc herniated anteriorly—removed at surgery.

variable. Very small (usually round) nuclei are seen measuring less than 1 cm. in diameter, whereas the large ones (rectangular) may measure 2.5 cm. (Fig. 4). We have not observed a correlation between the size of the nuclei and the stature of individual. A stout stenic male may have small nuclei and a slender hyposthenic female may have large nuclei.

THE ABNORMAL DISC

The discogram reveals that a disc may rupture in a single or in multiple directions, namely anteriorly, posteriorly, posterolaterally and/or vertically. The *posterior tear* is most common; the fibers of the annulus, anterior to the nucleus will contain no contrast material and are therefore considered to be intact. Posteriorly, the diodrast obliterates the "clear space" normally occupied by the fibers of the annulus and often protrudes beyond the anterior wall of the spinal canal (Fig. 5*A*). In severe posterior ruptures, the posterior fibers of the annulus (Sharpey's fibers) may be extensively torn from their attachment to the cartilaginous plate of the vertebral body. In this instance, the diodrast escapes beneath the posterior longitudinal ligament (Fig. 9*B*). The frequency of posterior rupture of the annulus, demonstrable by discography, is in accord with the anatomical studies of others. Schmorl,[13] whose opinion was based on the investigation of 8,000 spines, stated in 1930 that the annulus fibrosus is less dense posteriorly than anteriorly or laterally, and that the disc is less firmly fixed in osseous structure at the posterior circumference of the vertebrae. The mechanism of injury to these fibers is due to hyperflexion of the spine accompanied by torsion. Greater strain is thus applied to the posterior annulus frequently resulting in laceration.

Posterolateral extrusion of the contrast material is observed in cases whose disc syndrome includes sciatic pain. If a posterior herniation is detected in the lateral view and the anteroposterior roentgenogram discloses an intact annulus bilaterally, then a midline herniation has occurred; clinically these patients usually complain of severe back pain without sciatica. We have studied the cause of midline protrusion of the disc, anatomically. A careful examination of the anterior wall of the spinal canal during surgical exploration has disclosed an absence, or rudimentary development, of the posterior longitudinal ligament. This permits the herniation of the disc material posteriorly in the midline. The normal ligament occupies the middle third of the anterior wall of the spinal canal. In the presence of a well developed ligament, the disc material is deflected posterolaterally where it comes in contact with the nerve roots.

Although the posterior herniations of the injured disc are considered to be most common, the discogram has disclosed a surprising number of *anterior herniations of the disc* with or without rupture of the posterior fibers of the annulus. Our first recognized anterior herniation was an unexpected finding[2] (Fig. 6*D*). Subsequently, numerous similar cases have been observed. The roentgenogram may demonstrate the opaque material extending to or beyond the anterior longitudinal ligament (Fig. 6*A*). Narrowing of the intervertebral space and hypertrophic osseous changes (osteophyte formation) about the margins of the vertebral bodies are indicative of a ruptured disc lesion of long duration. When these findings are present, the diodrast may extend beyond the confines of the intervertebral space, collecting in the paravertebral space (Fig. 6*B* and *C*). In the lateral view, the opaque medium may follow the contour of the "eagle beak" spur protruding from the anterior rim of the vertebral body (Fig. 6*A*).

A tear or detachment of the anterior longitudinal ligament may permit a large quantity of diodrast to collect anterior to the disc. A similar false positive roentgenogram can be produced if the needle is inserted too far forward in the disc (beyond the confines of the nucleus pulposus). The diodrast can be forced through the

fibers of the anterior annulus and will collect anterior to the interspace beneath the attachments of the anterior longitudinal ligaments, simulating a rupture of the anterior annulus. If the procedure is repeated with the point of the needle correctly placed, these fibers will be found intact. A thin line of contrast medium following the anterior longitudinal ligament usually indicates a sequestrated fragment of the disc herniating anteriorly acting as a space taking mass which the diodrast outlines (Fig. 6*D*).

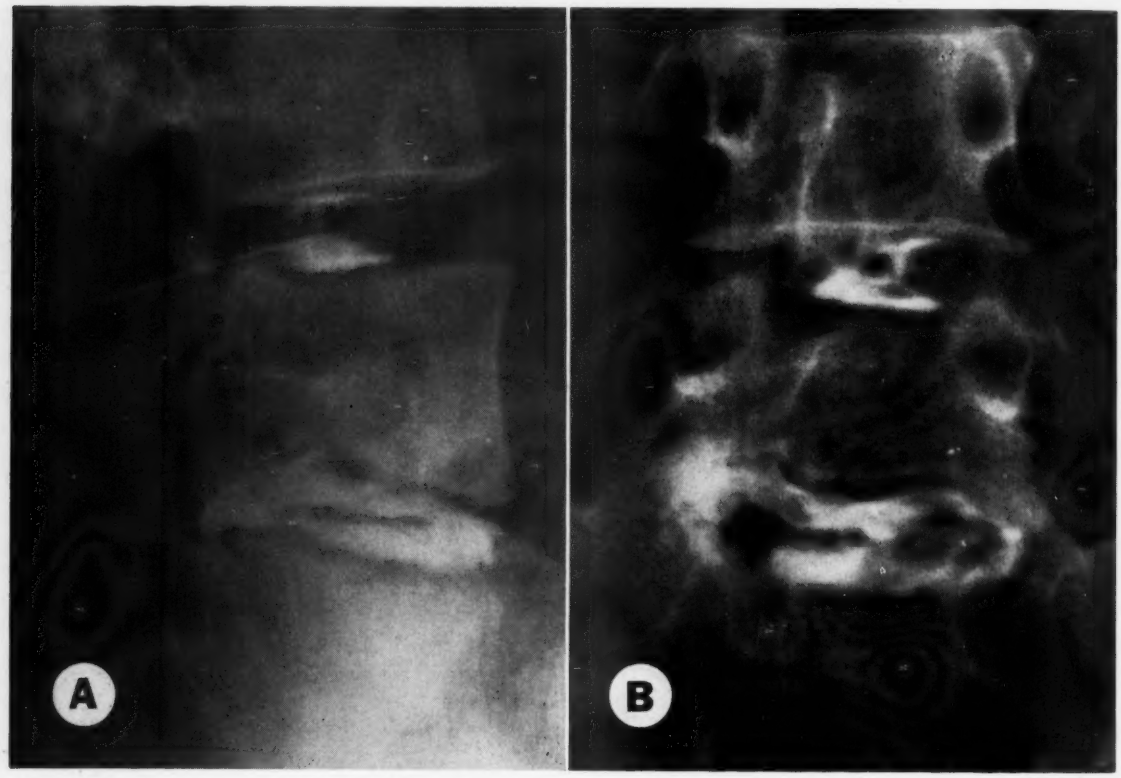

Fig. 7. Complete rupture of lumbosacral disc. Diodrast fills the entire interspace indicating disorganization of entire annulus fibrosus.

As stated above, these alterations in the anterior third of the disc may be accompanied by the absence of opaque material posterior to the normal confines of the nucleus pulposus, indicating the posterior annulus to be intact (Fig. 6*A*). In such a case the myelogram would present no evidence of a ruptured disc. The most frequent finding, however, is a complete disorganization of the entire annulus which permits the length and breadth of interspace (spinal canal to the anterior longitudinal ligament) to fill with the diodrast (Fig. 7*A* and *B*). The ruptured discs of long standing usually exhibit this appearance, indicating that after the initial loss of the noncompressible supporting mechanism of the nucleus pulposus, movements of the spine eventually grind up the fibers of the annulus, tearing and disorganizing the disc. The failure to recognize the presence of these "hidden discs" and their relationship to the cause of low back pain due to trauma may account for disappointing results obtained by surgical treatment. Lewey[9] reported that less than 33 per cent of patients with a "bulging" disc experienced benefits from surgical treatment. The knowledge of the extent of the rupture of the interior of the disc, especially anteriorly as demonstrated by the disco-

Fig. 8. The degenerated disc. Marked narrowing of intervertebral space with adjacent marginal osteophytes noted in preliminary roentgenograms. Degeneration and absorption of disc demonstrated by disc space filling with diodrast and extending outside intervertebral space around its entire periphery (the "flat tire" disc). A firm ridge across the anterior wall of spinal canal is seen on surgical exploration, formed by bulging of annulus fibrosus and osteophytes (arrow).

gram, may alter the type of treatment advised and improve the result.[3]

The so-called *degenerated disc* is evident in the routine roentgenograms of the spine. The collapsed disc of long standing results in narrowing of the intervertebral space and local osteophyte formation on the margins of the adjacent vertebral bodies. (Fig. 8*A* and *B*). The discogram in these narrow interspaces shows a thin line of the opaque material extending throughout the entire interspace and usually beyond (Fig. 8*D*). A bulging of the anterior longitudinal ligament (the flat tire disc) is outlined by the contrast medium, indicating a disorganization of the peripheral fibers of the annulus fibrosus beneath. These findings are so constant that a discographic visualization of the markedly narrowed interspace is not necessary to make a diagnosis of a ruptured disc, although the discograms are interesting to see (Fig. 8*C*). Clinically, these patients have only back pain, as a rule; if sciatica is present it is usually bilateral.

Demonstration on the discogram of *herniations of the disc superiorly or inferiorly* into the body of the vertebrae have been interesting. No attempt will be made here to describe the pathology of the Schmorl node, a subject which flooded the medical literature during the late 1920s. We will merely indicate that a focal defect in the cartilaginous plate of the disc, either as a result of a congenital imperfection, a necrotic area due to disease or a fracture due to trauma, may permit herniation of the nucleus pulposus into the vertebral body. In the Schmorl nodules of long standing, sclerosis of the defect, marginally, is manifested roentgenographically by a rim of increased density outlining the cavity (Fig. 9*A*). In ruptured discs of recent occurrence, superior or inferior herniations of the nuclear material into the spongiosum may not be suspected unless demonstrated by discography. Because of the thickness of the vertebral body (in the lateral projection) and the absence of a sclerotic margin about the "nodule," they may not be demonstrable or identified in the routine roentgenograms of the spine. But, when diodrast is injected into the interspace, the size and shape of the defect in the vertebral body will be outlined (Fig. 10*A* and *B*). When a Schmorl nodule exists, the discogram will almost invariably reveal a collapse and disorganization (complete

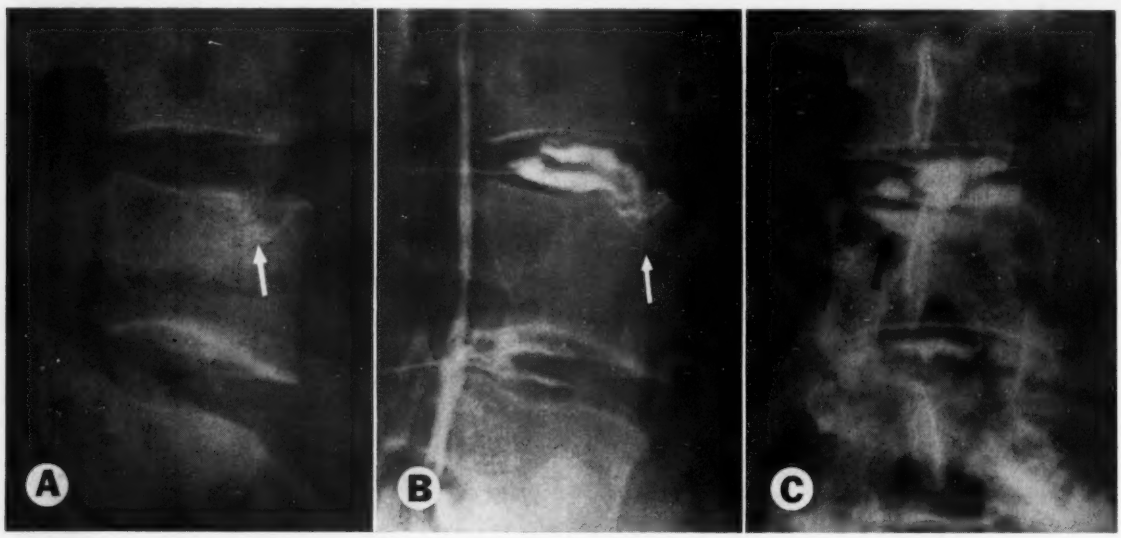

Fig. 9. Schmorl's node of long duration. (*A*) Note marginal sclerosis of defect in superior surface of L-3. (*B*) Discogram demonstrates nuclear material extending anterior and inferior into bony defect (arrow). At L4-5 a posterior rupture of annulus fibrosus has permitted extrusion of diodrast into spinal canal.

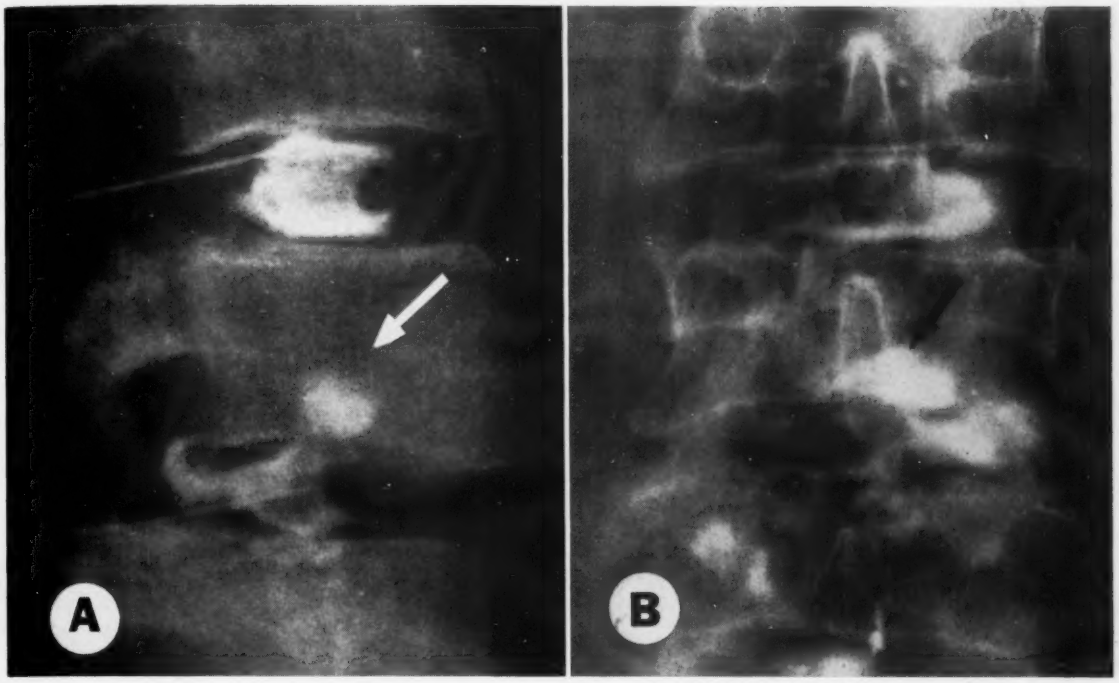

Fig. 10. Superior herniation of nucleus pulposus from traumatic rupture of cartilaginous plate. Posterior herniation also present. A fifty-seven year old man with moderate osteoporosis of vertebrae. Severe low back pain and left sciatica following back injury—heavy lifting. The lesion in vertebral body, not evident in routine roentgenograms, was assumed to be of recent origin, probably resulting from the injury. Congenital weakness of cartilaginous plate may have been a predisposing factor. Note slightly narrowed intervertebral space L4-5 from loss of nucleus. A normal cup-shaped nucleus at L3-4.

rupture) of the remainder of the disc (Fig. 9*B*). The presence of a Schmorl nodule in the lower lumbar vertebra, whether demonstrated by routine roentgenograms of the spine or discogram, indicates a loss of the supporting structure of the nucleus pulposus, and may be interpreted as a vertically ruptured disc, producing low back pain. The Schmorl nodules in the upper lumbar and thoracic spine are usually asymptomatic.

SUMMARY AND CONCLUSIONS

A technique of performing discography has been presented. The various types of nucleus pulposus in the normal (unruptured) disc are described. The abnormal disc (ruptured or degenerated) is depicted in its positional deviation, extent of rupture and direction of herniation. Examples of posterior ruptures with midline or unilateral herniation of disc material, also anterior herniations, with or without associated posterior ruptures, are illustrated. Finally, vertical ruptures of the nucleus pulposus into the vertebral body (Schmorl's nodule) are beautifully demonstrated by the discogram, often when the lesions were not suspected by routine roentgen examination of the spine.

A roentgenographic visualization of the lumbar intervertebral disc by injection of an opaque medium directly into the disc is a valuable contribution to the understanding of the pathological etiology of low back pain. The internal anatomy of the disc can be examined and unequivocal evidence of a ruptured disc demonstrated when all other methods of investigation, namely routine roentgenography, myelography and surgical exploration of the spinal canal have failed. It is our belief that this added information, by preoperative discographic demonstration of patho-

logic conditions of the lumbar disc, will revolutionize our criteria and methods of treatment for these lesions; it also seems reasonable to assume that we may anticipate a marked improvement in the end results of surgical treatment.

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Vol. 68, No. 4

ACROMEGALY AND CONTRASTING CONDITIONS

NOTES ON ROENTGENOGRAPHY OF THE SKULL

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INCIDENTAL to an investigation of the incidence, complicating disorders and other aspects of metabolic craniopathy (Morgagni's syndrome, hyperostosis frontalis interna, etc.), 6 examples of clinically diagnosed acromegaly were found in 456 females with one or another type of hyperostosis of the skull. There were in addition 3 cases which were subacromegalic and are termed "acromegaloid." In the class of hyperostosis known as hyperostosis calvariae diffusa were 2 cases of acromegaly in 198 females, and 1 among the 44 cases of hyperostosis in males (of 4,876 whose films were examined). The question naturally arose, Were these cases true examples of hyperostosis calvariae diffusa or was the thickened skull vault a feature of the acromegaly?

The general opinion seems to be that the vault of the skull in acromegaly increases in thickness, and in size equally with its visceral portion, and that enlargement of the sella turcica is an essential feature of its roentgen picture. Observations of the material in this study do not substantiate such opinions.

The roentgenogram of the skull in acromegaly cannot be effectively described. Briefly, the most striking feature is the disproportion of the facial to the cerebral division of the skull, the result of enlargement of the paranasal sinuses, the pneumatic cells of the mastoid processes of the temporal bones and overgrowth of the mandible out of proportion to that of the superior maxillae, resulting in separation of the teeth. There is also enlargement of the malar bones and their zygomatic processes, and prominence of the superciliary ridges.

The classification of all the material in this work was based on the roentgenogram with a later study of the hospital records of the patients. There are many gradations in development of acromegaly, dependent on age and perhaps on the action of endocrines other than the pituitary. There is remission and arrest (recession has never been recorded) and in the lighter forms the condition is compatible with perfect health, as witness the professional "strong men" and athletes. The clinical records carried the diagnosis of acromegaly in only 6 instances, all of them of extreme development. The lesser forms seem to escape notation in the history because they are overshadowed by the pathological condition that caused the hospitalization. There are 36 instances of acromegaly based on the roentgen findings alone. It is fully realized that so cataloging these cases is subject to criticism, because of overemphasis on the roentgenogram.

In roentgenograms of the skull, enlargement of the sella turcica is sometimes thought to be an essential part of the skull change of acromegaly. Enlargement is determined by measuring its depth and the distance between the anterior and posterior clinoid processes. This method is employed to evaluate the volume of the pituitary and its clinical import. Examination of the base of the skull in something over 1,000 human museum specimens and at many autopsies revealed that the pituitary fossa varied so greatly in size and shape in the normal that determining its dimension is of dubious value; certainly as a clinical criterion of pituitary activity. It is also to be remembered that this gland may be ectopic. Furthermore, it is possible that interaction of other endocrines may so influence it that activity may increase in the absence of detectable change in size of the gland and almost surely of the enclosing bony housing. If this last is eroded, greatly

Fig. 1. No. 75118. White female, aged forty-seven. Acromegaly, nodular toxic goiter, diabetes mellitus. Later, verified chromophile adenoma of pituitary.

enlarged and eroded, or has disappeared, conclusion to that effect is more satisfactory than measurement. Extrapituitary rather than intrapituitary conditions are the more frequent cause of enlargement, erosion and destruction of the sella turcica. Examples of the first are suprasellar cysts, aneurysm and adjacent tumors. Of the second, chromophobe adenoma has been the most frequent cause in this material. Chromophile and basophile adenomas appear to produce adverse effects through abnormal secretion rather than through

Fig. 2. No. 102824. White male, aged twenty-seven. Acromegaly. Vault of skull thin, sella turcica small. The small sella in acromegaly was described by Cushing in 1912.

size. Figure 1 is an exception to this opinion. On the other hand, possible ectopia of the pituitary minimizes or destroys any importance that might be attached to smallness of the sella turcica. Smallness of the sella was noted on 12 of the acromegalic skulls (Fig. 2). Measurement of the paranasal sinuses, the mastoid processes, and the superior maxillae is unsatisfactory. However, overgrowth or undergrowth of the mandible can be quite accurately estimated from the gnathion-obelion dimension.

In the ten year period of the study of hyperostosis, the roentgenograms of 10,064 patients were examined with the following result as related to hyperostosis and acromegaly (Table 1). At the time of examination the youngest and oldest acromegalics

Table I

	Acromegaly	Acromegaloid	Acromegaly with Hyperostosis	Acromegaloid with Hyperostosis
Males	24	3	1	0
Females	18	3	5	3
Total cases	42	6	6	3

were males seventeen and fifty-five, females eighteen and fifty-three years of age.

The disparity of occurrence of acromegaly in the sexes which is generally stated to be equal was not anticipated. In spite of repeated and critical examination of the material extending over a period of years, the sex difference in incidence cannot be explained. The number of cases examined were about equally divided between the sexes, which adds to the complexity.

It is also possible that the group of hyperostotics named hyperostosis calvariae diffusa by the writer would be classed by others as acromegaly, though that class, the most numerous of the five types of idiopathic calvarial hyperostosis, has no features in common with acromegaly. It will be shown that such thickening is only ex-

ceptionally, if at all, a feature of acromegaly; in fact, occurring only when combined with idiopathic hyperostosis.

It was found early in the hyperostotic study that it was necessary to establish definite points on the film of the skull where measurement of thickness could be made that would be constant and of comparable use from case to case or class to class. It was also believed necessary to bring thickness into relation with those dimensions of the skull least subject to roentgenographic distortion and that all points be as definite as possible. These are length, height, and greatest (roentgen-ray) dimension (these three are between exterior points). The diagram illustrates the details of these points (Fig. 3).

The measurements were made on a control group free of any condition of the skull that might modify dimension, 1,906 in number and about equally divided between the sexes. The ages were from the second to eighth decades inclusive. It may be mentioned here that no age differences in measurement were found after about the age of fifteen. The identical method of measurement was employed in the acromegalics, acromegaloids, and certain other related or possibly related conditions. These are an acromegalic giant, 2 cases of eunuchoid gigantism, idiopathic hyperostosis of the skull (metabolic craniopathy) and "thin skull." This last needs to be defined. It is a condition of symmetrical general thinness of the skull most pronounced at the bregma, is definitely a roentgenologic entity and is termed "hypoplasia of the diploë." There is an occasional localized type in the parietal, known as "symmetrical thinning of the parietal bone," and paradoxically it is sometimes unilateral. This is only mentioned because there is a specimen in the Robert J. Terry Anatomical Museum showing both the condition and acromegaly.

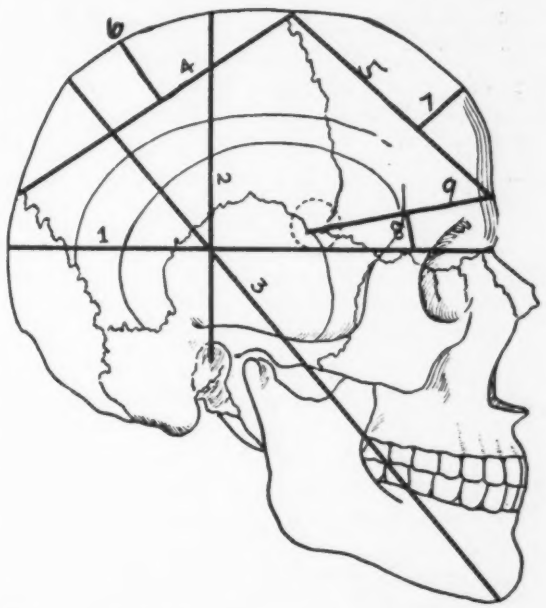

Fig. 3. Dimensions. *1*, nasion-occipital point; *2*, porus-vertex; *3*, gnathion-obelion; *4*, lambda-bregma; *5*, bregma-glabella; *6*, mid-parietal thickness; *7*, mid-frontal thickness; *8*, orbital plate thickness; *9*, orbital plate length.

No. *6* is a misnomer. It is the thickness at the halfway point of the interparietal suture.

Table II

ACROMEGALIC SKULLS
Average Measurements in Millimeters

	Male (24)	Normal	Female (18)	Normal
Nasion-occipital point	212	215	212	205
Porus-vertex	140.5	139	135	134
Gnathion-obelion	285	278	273	264
Lambda-bregma	146	144	138	139
Bregma-glabella	99	105	94	99
Thickness				
Mid-parietal	7	8	8	7.6
Mid-frontal	5	5	7	5.9
Orbital plate	2.5	1.89	2	2.2
Orbital plate length	58	64	55	64

Comparison of the skull dimensions in acromegalics and the normal is given in Table II.

Table III illustrates skull thickness in acromegaly and possibly related conditions.

Excepting the eunuchoid the following is observed. The length of the skull is lightly greater in the abnormal females than in

TABLE III

AVERAGE MEASUREMENTS OF ACROMEGALY AND ALLIED CONDITIONS IN MILLIMETERS
Both Sexes: Decades 2–8 Inclusive

	Nasion-Occipital Point	Porus-Vertex	Gnathion-Obelion	Lambda-Bregma	Bregma-Glabella	Thickness			Orbital Plate Length
						Mid-parietal	Mid-frontal	Orbital Plate	
Normal	210	136	258	140	102	7.33	5.34	2.02	64
Acromegaly, uncomplicated	217	139.6	282	145.6	99.8	7.9	6.3	1.8	52.8
Normal	208	136	258	140	102	7.33	5.34	2.02	64
Acromegaloid, uncomplicated	208	136	273	136.0	94.0	8.6	6.6	2.6	51.0
Normal	208	136	258	140	102	7.33	5.34	2.02	64
Acromegaly with hyperostosis	207	135.0	276	150.0	97.0	10.0	10.0	2.0	50.0
Normal	208	136	258	140	102	7.33	5.34	2.02	64
Acromegaloid with hyperostosis	218	130.0	262	132.6	101.0	10.0	9.6	1.6	63.0
Normal	208	136	258	140	102	7.33	5.34	2.02	64
Acromegaly with "thin skull"	203	125.0	293	156.0	101.8	7.5	5.0	1.2	56.5
Normal	208	136	258	140	102	7.33	5.34	2.02	64
Acromegalic Giant	259	145.0	356+	164.0	115.0	10.0	11.0	1.0	50.0
Normal	208	136	258	140	102	7.33	5.34	2.02	64
Eunuchoid Gigantism	207	128.0	261	140.0	101.0	6.0	7.5	2.5	64.5

the males. This paradox evades explanation, because the larger size of the frontal sinus in both the normal and abnormal male would indicate the opposite to that which was observed. Skull height is consistently unchanged throughout, as is the thickness of the orbital plate of the frontal bone and the distance between lambda and bregma. The chin-vertex length of head was much greater than in the controls in both sexes. Thickness at the mid-parietal and mid-frontal points is below normal in males and slightly greater in females, the largest difference occurring in the subjects with hyperostosis. The distance from bregma to glabella and the length of the orbital plate of the frontal bone is diminished throughout in the abnormal males and females. This is the result of the larger development of the frontal sinuses in the first instance and of the posterior ethmoid sinuses in the second.

Skull abnormalities in acromegaly are, as far as the roentgenogram can determine, confined to its visceral portion. The vault does not thicken nor is the capacity of the brain case altered except by a slight decrease through extension of the frontal sinus backward and possibly the ethmoids upward. Perhaps the sphenoid expands upward also. However, as is the case with the pituitary fossa, normal variation is so great coupled with frequent small size of the structures as to render exact determination of their size impossible with present methods. Only the frontal sinus can be satisfactorily estimated as to size; no feasible method of measuring it was devised. In the review of the films of the hyperostotics, the size and position of the

frontal sinus was noted as large, small, and in low position, or absent. The notations were on the female cases, the male hyperostotic cases because of their small number, had no variations recorded. The small, low placed frontal sinus approximates that of childhood. It was recorded in 20.83 per cent of all types of hyperostotics and was nearly four times more frequent in hyperostosis clavariae diffusa and nebula frontalis than in all the other types combines. No frontal sinus was observed in 8 cases, the majority being hyperostosis frontalis interna. The sinus was estimated as being enlarged in 5 cases.

There is a well marked disposition to trace acromegaly and metabolic craniopathy to a common source—disorder of the pituitary—which the future more than probably will prove to be the case. This should not lead to the belief that an identical abnormal function of the gland is at work in both conditions since they differ so radically in manifestations but particularly in the tissues and anatomical divisions affected. Except for the vault, and to some extent the base of the skull, as far as is now known, the skeleton in metabolic craniopathy is unaffected. Other tissues found to to be involved are few—adipose tissue, the pilary areas of the skin, functional disorder of the central nervous and muscular systems. There is no alteration of stature, splanchomegaly, acral enlargement or change of facies, air cavities, oral cavity or articulation. Metabolic craniopathy occurs 98 to 100 times more frequently in women than in men; acromegaly has a quite different incidence. The two conditions may co-exist as shown above.

This paper is a by-product of an investigation which in its origin appeared to be unrelated to the conditions which are presented. Frequent allusions to acromegaly in the literature of hyperostosis frontalis interna and Morgagni's syndrome proved so confusing to the writer that it was necessary to clarify, as far as possible, the relationship, if any, between the conditions described and crystallized those ideas gained from the media employed, chiefly the roentgenograms. It is hoped that what is set forth will be helpful to those interested in these problems.

CONCLUSIONS

(1) Acromegaly and metabolic craniopathy are both, because of their bilateral symmetry, a constitutional condition.

(2) Both vary in degree of development, and hence of impairment of health. In the extremes each is a serious disorder.

(3) In hyperostosis the skull only is involved and at the expense of the cranial cavity.

(4) There are radical differences objectively between the two conditions. The vault is not thickened in acromegaly; on the contrary, it is thin except occasionally.

(5) The sella turcica is not necessarily enlarged in acromegaly and not at all in hyperostosis. In both it may be and frequently is small in size. Enlargement of the sella is due to intrasellar conditions, most frequently to chromophobe adenoma.

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SKELETAL CHANGES IN MYELOMATOSIS, LYMPHOSARCOMA AND OSTEOMYELOSCLEROSIS*

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SKELETAL changes in blood diseases consist of bone defects, osteoporosis or osteosclerosis. These lesions will be encountered in chronic leukemias, hereditary blood diseases, such as, *e.g.*, Cooley's anemia, further in hemolytic icterus, myelomatosis, myelosclerosis, etc.

MYELOMATOSIS

According to recent researches made by Apitz[1] and other authors, Kahler-Bozzolo's disease, of which the first observation was made by McIntyre in 1850, is considered to be a growth of myeloid plasma cells or of their preliminary stages. Thus, Apitz suggested, instead of myeloma, the term plasmocytoma and plasmocytosis for the diffuse type. In respect to its starting point in myeloma or plasmocytoma, a medullary type can be distinguished, which involves the skeletal system, and another, rarer type involving soft tissue organs, the extramedullary type. The latter type, however, of which the commonest site is the mucosa of the upper respiratory tract, will concern us only insofar as it includes involvement of the osseous system.

Plasmocytoma is a disease of later life; it occurs generally in the sixth and seventh decades. Among the 38 patients of the Institute of Radiology of the University of Zürich 31.5 per cent were between the ages of fifty and fifty-nine and 34.2 per cent between sixty and sixty-nine, 7.9 per cent between seventy and seventy-nine and 2.6 per cent over eighty. This means that 76.2 per cent of all cases occurred in individuals over fifty years of age. The youngest patient was thirty-one years old, the oldest eighty-four; the average age was 57.3 years. Sixty-three per cent of our cases occurred in males having a mean age of 51.3 years. The occurrence of plasmocytoma in younger patients is very rare. Geschickter and Copeland[7] found only 5 definite cases, all between twenty and thirty.

Clinically plasmocytoma is characterized by intermittent pains, generally considered as rheumatic, weakness, emaciation, appearance of tumors, pathologic fractures, deformities of the trunk, nephroses or nephritis and renal insufficiency.

The hematologic picture is rather uncharacteristic. The leukocyte count is usually normal or somewhat low. Therapy resistant hyper- or hypochromic anemia frequently occurs. The erythrocyte sedimentation rate is remarkably increased. Frequently, in the peripheral blood some plasma cells can be observed; in cases with numerous plasma cells, plasma cell leukemia or leukemic plasmocytosis (Apitz) is present, which was formerly ascribed to lymphatic leukemia.

Examination of the blood chemistry shows hyperproteinemia, which almost always means hyperglobinemia. The serum calcium values are elevated, the phosphatase, in contrast to hyperparathyroidism, is normal to low. The Takata-Ara test often is positive. Frequently, in the urine there are Bence-Jones bodies, which, however, present no constant finding. They can be observed in 45 to 70 per cent of the cases. The excretion of Bence-Jones bodies sometimes changes during the course of the disease; it is not specific for myeloma.

The electrophoretic analysis of the serum, with which velocity of migration of a protein in a constant electric field is measured, shows separation into several

* Presented at the Sixth International Congress of Radiology, London, England, July 23–30, 1950.

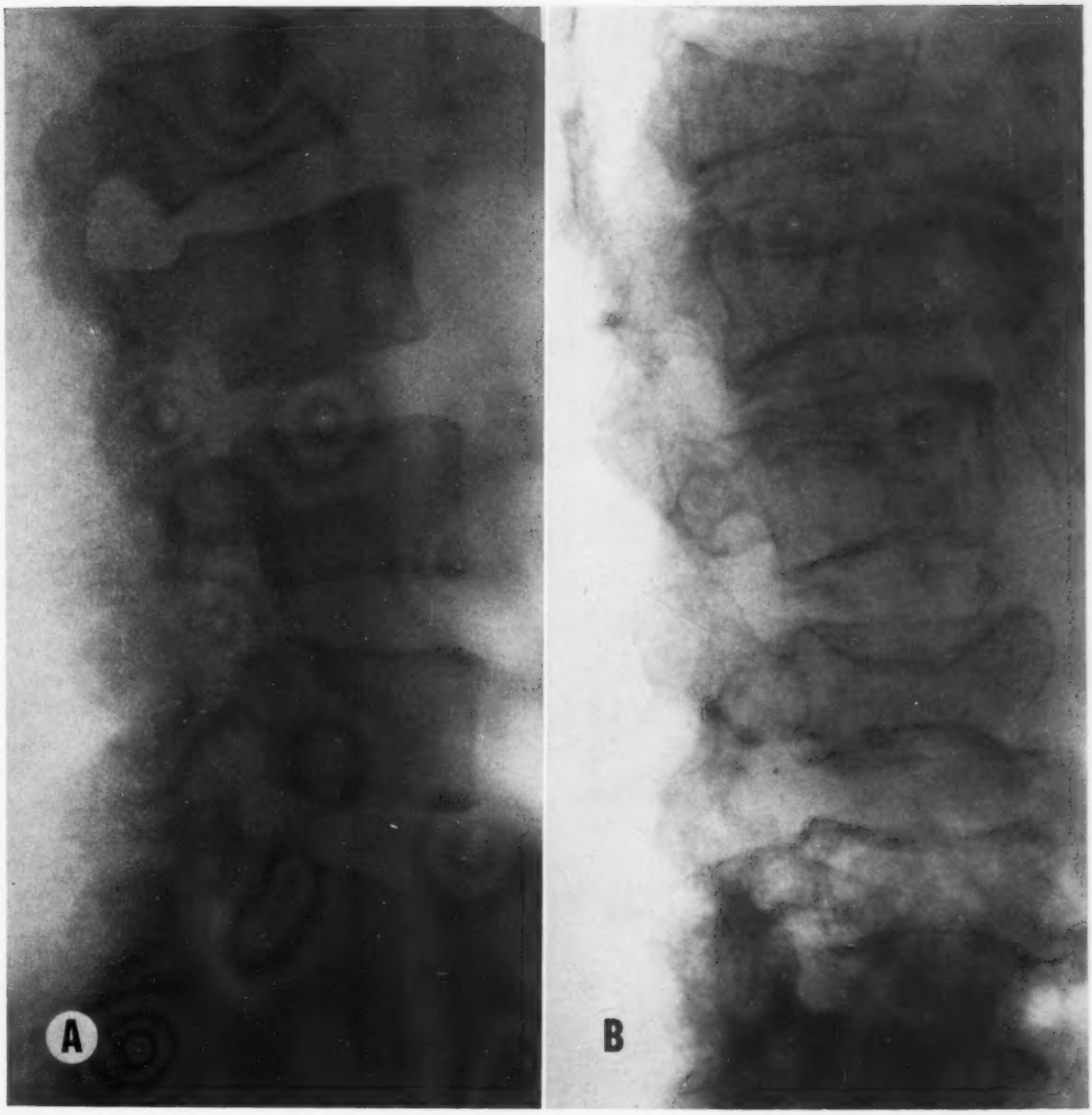


Fig. 1. (*A*) Diffuse osteoporosis (plasmocytosis) in a man, aged forty-nine. (*B*) Two years and five months later: hypertrophic atrophy. Biconcave, "fish vertebrae," infractions.

groups of globulin (the alpha, $beta_1$, $beta_2$ and gamma groups). According to researches made by Wuhrmann, Wunderly and Hugentobler,[33] the alpha-globulin types belong to cases with the shortest duration of life and the gamma-globulin types to those with a relatively long survival. As regards the histologic or cytologic picture, cases with numerous immature and atypical plasma cells belong much more to the alpha group. However, the more the plasma cells are mature and typical, the more they belong to the gamma group.

The prognosis is very unfavorable. The average survival in our cases was two years and one month. The shortest period was one month, the longest fourteen years.

Anatomically three different types can be distinguished: (1) diffuse infiltration starting presumably from a localized growth which, according to Apitz, is considered to be the precocious form of the

Fig. 2. Clear-cut, punched-out focus in the middle of the left humerus. Large focus in the upper epiphyseal-metaphyseal region. Third focus in the left clavicle. Plasmocytoma in a sixy-nine year old man.

disease. It is called plasmocytosis; (2) the multiple nodular growth following from diffuse infiltration. Frequently the first type is combined with the second type; (3) the solitary type, which is occurrence of a single bone tumor.

The first and the third types are very rare. Generally both types pass over to the second. The time from the first observation to the onset of generalization or appearance of multiple tumors varies from two months to four years and more. The cases which remained localized and solitary for a long period, *e.g.*, four to twelve years, are very rare. Among our cases there is only one patient with solitary plasmocytoma of the humerus with a survival of eleven years after operation and postoperative irradiation. However, of the reported cases, for the most part, the period of observation is not long enough to judge correctly if they are purely solitary. Anatomically there is no difference between solitary or multiple plasmocytomas.

Roentgenologically, two main types of skeletal lesions occur. The first is characterized by diffuse osteoporosis, the second by osteolytic lesions.

Purely *diffuse osteoporosis* is a very rare finding. The rarity chiefly seems to be due to the fact that an exact diagnosis in these cases can only be made by marrow puncture. Osteoporosis can occur in almost the whole osseous system, especially in the spine, skull and pelvis. Often it is the precocious stage to the second type, the osteolytic lesions. In Figure 1*A* an osteoporotic lumbar spine of a man, aged forty-nine, is seen. It was the single finding of the disease proved by sternal puncture. Six months later osteolytic lesions were already found in different regions of the skeleton. The spine showed after a period of two years and five months (Fig. 1*B*), instead of uniform porosis, coarsely thickened bone structure (hypertrophic atrophy) and biconcave vertebrae, later also infractions of several dorsal vertebrae. Thus, osteoporosis presents diffuse plasma cell infiltration, which can be verified histologically or cytologically. *It belongs to the roentgenological picture of myelomatosis just as much as the so-called typical osteolytic lesion.* And, sometimes, it may be the single roentgenological feature of the bone lesion.

The *osteolytic bone lesions* are characterized by oval or rounded, more or less sharply limited, punched-out transparent areas, varying from the size of a millet seed to an apple. They can appear as a single focus (solitary plasmocytoma) or as multiple foci, all without sclerotic reactions. The miliary lesions often have a moth-eaten appearance. Generally, the multiple bone lesions are associated with osteoporosis. Figure 2 shows a clear-cut, punched-out radiolucent change in the middle humerus, a larger focus in the upper epiphyseal-metaphyseal region, and a third focus in the

acromial clavicular end. The primary lesion of this case was an extramedullary plasmocytoma. Generalized punched-out patches in the diaphysis of a humerus are seen in Figure 3. There is practically no normal spongiosal structure. Thus, pathological fractures occur most frequently in

Fig. 3. Generalized foci in the diaphysis of the left humerus of a fifty-two year old female patient. Myeloma proved by sternal puncture. Electrophoresis showed alpha-globulins. (Case of Prof. Wuhrmann, Zürich.)

Fig. 4. Destruction of the anterior outlines of the third cervical vertebra by plasmocytoma in a sixty-five year old man.

these areas—in about 40 to 60 per cent of all cases—especially in the vertebrae, ribs, long bones and clavicles. Some patients had several fractures in three or five different bones. Often in the spine the plasma cell growths destroy the bone outlines (Fig. 4) producing pathological fractures of the vertebrae and resulting in wedge-shaped or flattened vertebrae (Fig. 5). The small vertebral joints, however, always remain intact. Vertebral infractions lead sometimes to noticeable deformities of the trunk.

Spread of bone destructions occurs within a period of several months to several years. In Figure 6*A* a roentgenogram of the skull of a female patient aged fifty-six taken previous to admission to the hospital is reproduced. The destructious were localized only in the frontal bone. Four months later the destruction areas already are passing over to the parietal bone (Fig. 6*B*). A typical roentgenogram of the skull showing rarefications and tumor involvement is seen in Figure 7. The various foci vary in

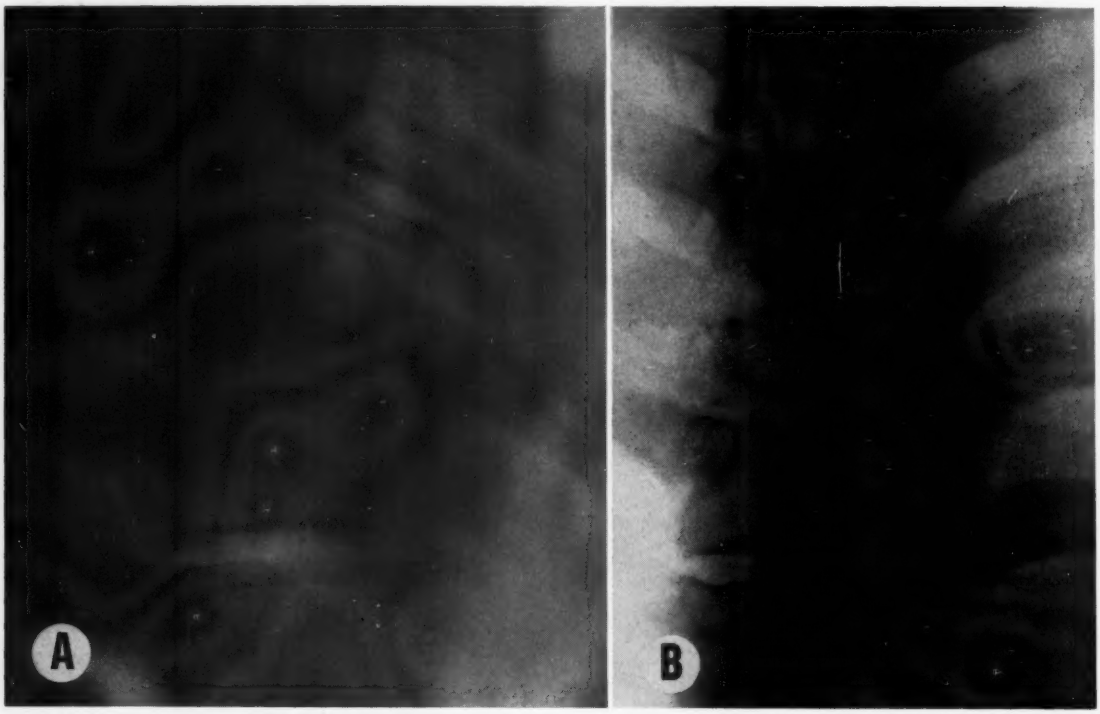
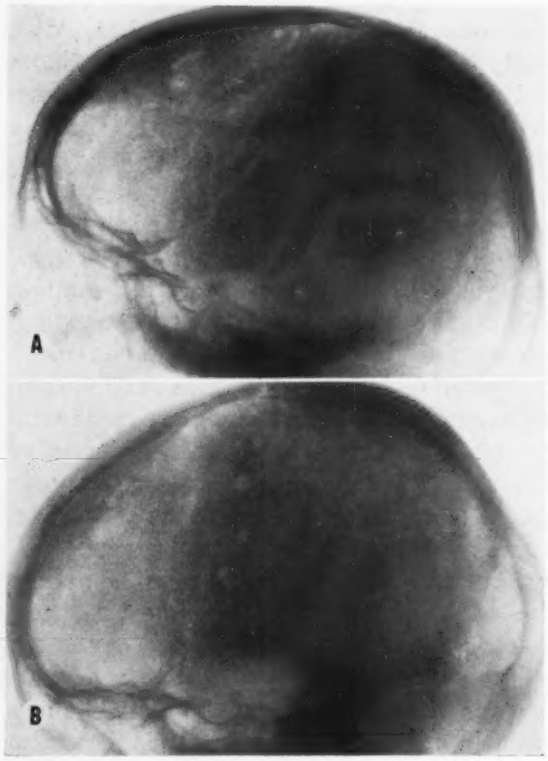


Fig. 5. (*A*) Almost completely flattened vertebra of a man aged thirty-three with plasmocytoma. (*B*) In the anteroposterior projection the lesion assumes the aspect of a tuberculous abscess.



size from that of a pinpoint to that of an apple. In Figure 8 multiple foci of almost uniform size are seen, so that the skull presents a granular appearance.

Sometimes, as the disease progresses, the affected bones are completely enlarged by the tumor, especially the ribs, ischium and upper femur. In Figure 9 osteolytic lesions are seen in the left femur having the appearance of miliary honeycombs; in addition, larger destructions are seen. The pubis and ischium are expanded with complete lack of new bone formation. The cortex is extremely thinned. Continuous increase in size of the tumor leads to complete destruction of the bone (Fig. 10).

On the other hand, osteolytic bone lesions appeared also as trabeculated, cystic tu-

Fig. 6. (*A*) Roentgenogram of the skull of a woman, aged fifty-six, taken previous to admission to the hospital. (*B*) Skull of the same patient four months later. Note the progressive destruction which is passing over to the parietal bone.

mors. The bone is blown up, and the roentgen appearance is that of a soap bubble. This type is chiefly encountered in the sternum (Fig. 11) and on the clavicle. The roentgenogram of an extremely large cystic area of bone destruction of the ilium is seen in Figure 12. The patient was a sixty-four year old man under observation for fourteen years.

The most frequent sites of involvement of the osseous system in plasmocytoma are the skull, the ribs, spine, pelvis, especially the ischium, pubis, and femur. Occasionally, only bone destruction of the scapula, mandible, radius, fibula and tibia is found.

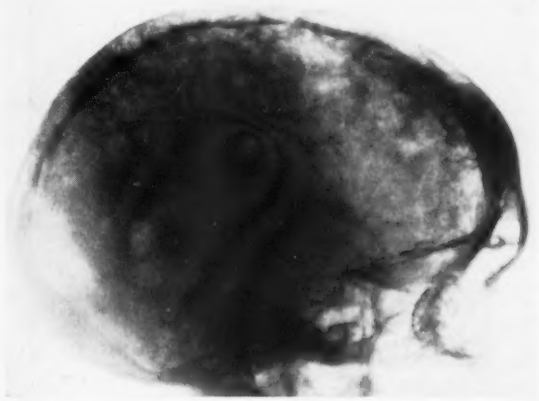


Fig. 7. Typical roentgenogram of the skull in plasmocytoma. Female, aged sixty-two. Gamma-globulin type. Under observation ten months.

Fig. 8. Granular appearance of the skull caused by multiple myeloma foci in a fifty year old female patient.

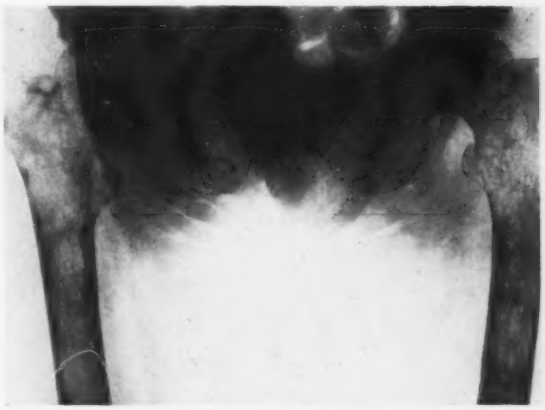


Fig. 9. Osteolytic lesions in the femora (on the left, honeycombs), pubis and ischium. Patient, female, aged fifty-seven, with generalized plasmocytoma.

Fig. 10. Osteolysis of the right pubis. Female, aged fifty-one. Under observation five years.

In a single case osteolytic lesions were found in the calcaneus.

With the exception of the roentgenological appearance of the moth-eaten bone lesions in multiple plasmocytoma, no difference could be observed by comparing the bone lesions in cases of solitary or multiple plasmocytoma, medullary or extramedullary plasmocytoma and the bone lesions of the different globulin groups. It is to be noted, however, that the roentgenograms of the skull of our 3 cases of the alpha-globulin group showed only a few small lesions, whereas the other bones were diffusely affected.

Fig. 11. Trabeculated-cystic form of plasmocytoma of the sternum.

A few words about the *effect of the treatment* on the skeletal changes. Plasmocytoma is scarcely radiosensitive. Recalcifications were found relatively seldom. Among our 26 patients treated with roentgen therapy it was observed in only 4 cases. In the first case, a case of solitary plasmocytoma, osteosclerosis occurred in the operated and postirradiated region. The second case belongs to the trabeculated-cystic type. In Figure 13*A* the left shoulder of a sixty year old man is seen, seven months before the beginning of roentgen therapy. Figure 13*B* shows the shoulder just at the beginning. Meanwhile the tumor has increased remarkably. Figure 13*C* shows the shoulder one year and four months after the treatment was terminated. The trabeculae are noticeably sclerotic in comparison with the first roentgenograms. Interesting is also the third case, in which extensive bone destruction of the right ilium was found before roentgen therapy. One year and two months after the treatment osteosclerosis could be observed in the middle of the area of destruction, which, however, disappeared during the following ten months, at the same time showing increase of the bone tumor. In the fourth case recalcification was found four years after roentgen treatment of two expanded osteolytic ribs in a man, aged sixty-five. In all the other cases, except relief of pain, no remission could be obtained. The bone lesions remained the same or became progressive. The same can be said concerning the treatment with stilbamidine.

In conclusion, we can say that none of the described roentgenological features is specific for plasmocytoma. It can be exactly diagnosed only together with histological or cytological and laboratory examination. Plasmocytosis must be differentiated from senile osteoporosis, chronic leukemias, avitaminosis, hormonal diseases (*e.g.*, Cushing's syndrome). The trabeculated-cystic

Fig. 12. Extremely large cystic bone destruction of the ilium, ischium and pubis in plasmocytoma. (Case of Prof. Uehlinger, St. Gall.)

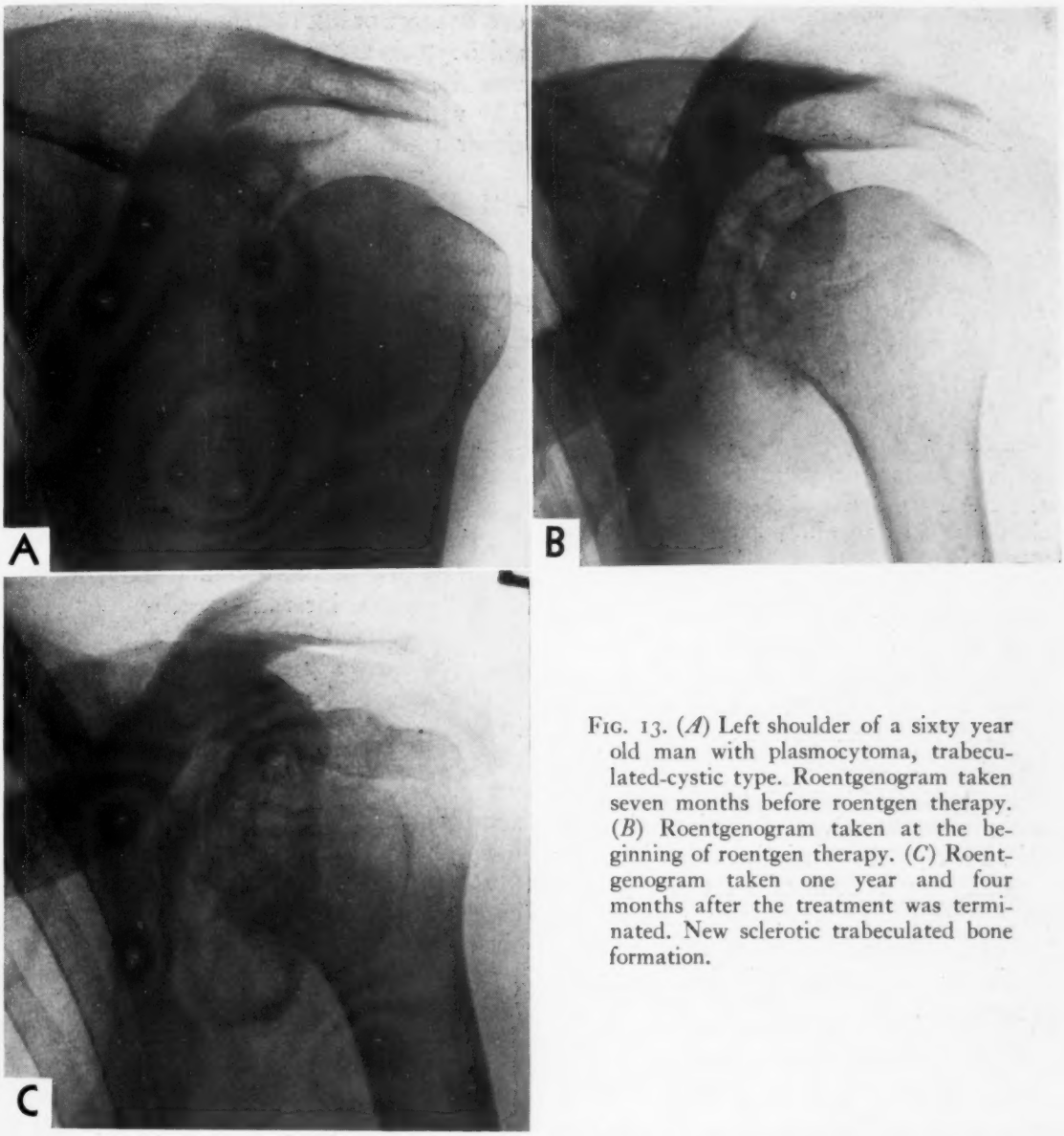


Fig. 13. (*A*) Left shoulder of a sixty year old man with plasmocytoma, trabeculated-cystic type. Roentgenogram taken seven months before roentgen therapy. (*B*) Roentgenogram taken at the beginning of roentgen therapy. (*C*) Roentgenogram taken one year and four months after the treatment was terminated. New sclerotic trabeculated bone formation.

type of plasmocytoma must be differentiated from osteoclastoma, the other osteolytic lesions from bone carcinomatosis, eosinophilic granuloma, hemangioendothelioma, Jaffe-Lichtenstein's disease (osteitis fibrosa cystica), Hand-Schüller-Christian disease and Ewing's sarcoma.

LYMPHOSARCOMA

Bone involvement in lymphosarcoma is extremely rare and is of a terminal nature. It should occur in about 7 to 10 per cent of all cases of lymphosarcoma. We have to distinguish between primary sarcoma, formed in the lymph follicles of the bone, and secondary sarcoma presenting bone metastases of generalized extraosseous lymphosarcomatosis. In contrast to osseous metastases in extramedullary plasmocytoma, osseous metastases in lymphosarcoma occur much more frequently than primary lymphosarcoma of bone.

The roentgenological appearance bears great resemblance to that of plasmocytoma. Figure 14 shows the skull of a man, aged twenty-eight, with primary lympho-

Fig. 14. Roentgenogram of the skull of a twenty-eight year old man with primary bone lymphosarcoma.

sarcoma of bone. We see the same punched-out lesions as in plasmocytoma. The same lesions are seen in the ribs, clavicles and pelvis. The roentgenogram of the spine reveals diffuse osteoporosis. Also trabeculated-cystic lesions are reported and, in a few instances, sclerotic changes (osteoplastic metastases), and periosteal reactions. Purely sclerotic lesions should occur in about 5 per cent of all cases (Vieta, Friedell and Craver[44]). The commonest sites of bone involvement were ribs, spine and femur. Also pathologic fractures were encountered.

OSTEOMYELOSCLEROSIS

Osteosclerotic changes in blood diseases are rather rare. They are found in addition in myeloid leukemias and, extremely rarely, in lymphoid leukemias, also in myelosclerosis which in this case is called osteomyelosclerosis or, according to Rohr, also osteomyeloreticulosis. This term was suggested because of the close relationship to the myeloid and osteogenous reticulum. This disease is characterized by the following triad of symptoms: (1) splenomegaly, generally very marked; (2) myelofibrosis, many times associated with osteosclerosis; (3) myeloid blood reaction showing erythroblasts, myeloblasts, myelocytes. There can be more or less increase of erythrocytes, anisocytosis and poikilocytosis, progressive anemia, and usually moderate leukopenia. The white blood cell count can also show either a normal picture or leukocytosis.

Due to the variety of the single clinical and hematological symptoms of osteomyelosclerosis, a multiplicity of names is encountered, such as aleukemic, megakaryocytic myelosis, megakaryocytic leukemia, myélose aleucémique ossifiante, myeloid megakaryocytic hepatosplenomegaly, leuko-erythroblastic anemia, myelosclerosis, etc. Furthermore, many cases of osteosclerotic anemia and chronic erythroblastoses of adults may be encountered in osteomyelosclerosis.

Osteomyelosclerosis is clinically characterized by hepatosplenomegaly, weakness, dyspnea, intermitttent bone or joint pains, sometimes by hemorrhagic diathesis. Rather frequently the general health does not appear to be disturbed. There is no increase in size of the peripheral lymph nodes. The disease usually lasts several years. It increases gradually in severity showing stationary intervals of more or less long duration. The prognosis is very unfavorable. In conformity to the reported cases the mean survival is five years and six months, varying from two months to twenty-three years. The youngest patient was a man aged twenty-nine, the oldest a man of seventy years. Generally osteomyelosclerosis occurs between the ages of thirty and sixty-nine. Out of 50 reported cases 12 per cent were between thirty and thirty-nine, 30 per cent between forty and forty-nine, 30 per cent between fifty and fifty-nine, and 24 per cent between sixty and sixty-nine. It occurs a little more often in men (56 per cent) than in women.

The causation is unknown. Osteosclerosis is considered by some authors to be the primary change of the disease, on the other hand, however, to be a secondary process. With respect to other authors, osteomyelosclerosis and splenomegaly are based upon the same cause.

The pathologic-anatomical examination

usually reveals splenomegaly due to myeloid metaplasia, with numerous polymorphonuclear megakaryocytes (polykaryoclasts according to Rohr), generalized hyperplasia of the bone marrow associated with increase of the myeloid elements, whole osseous system (Downey and Nordland, Lüpschitz, Bukh and With, and others).

Until recently, osteomyelosclerosis was identified only at postmortem examination, and there are only relatively few cases in

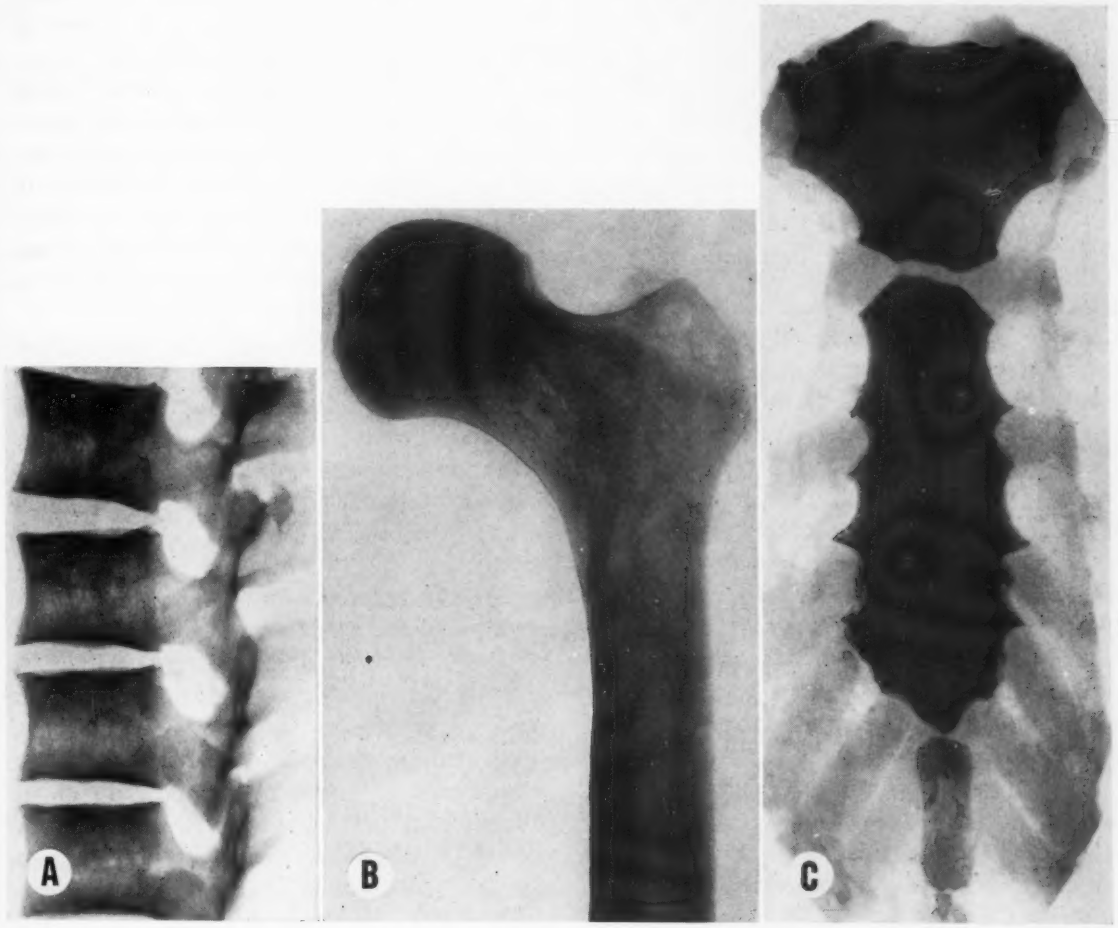


Fig. 15. (*A*) Vertebral bodies of a man, aged forty-one, with osteomyelosclerosis. (*B*) Femur and (*C*) sternum of the same patient. (Case of Prof. Uehlinger, St. Gall.)

and fibrosis. About one-third of the patients with myelofibrosis show generalized osteosclerosis. No change of the osseous outlines was observed. The spongiosa is hypertrophic and presents in the late stages of the disease irregular bone condensation. Thus, the marrow cavities may be filled with a very dense, irregular framework of bony trabeculae. The myelosclerotic and osteosclerotic foci, however, may not always uniformly involve the which osteomyelosclerosis can be diagnosed intra vitam by using sternal punture or biopsy and roentgenography. Roentgen examination of the bone shows marked increase in the number and thickness of the bone trabeculae and areas of mottling and rarefaction (hypertrophic atrophy). In Figure 15*A* the vertebral bodies of a forty-one year old man are seen and in Figure 15*B* the femur of the same patient with numerous areas of mottling. Some-

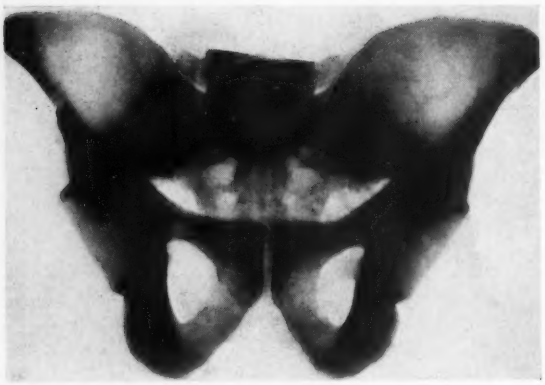


Fig. 16. Roentgenogram of the pelvis of the same patient as in Figure 15.

times the isolated and scattered condensation areas are inclined to confluence to such a degree that it may be difficult to distinguish the bone structure. In Figure 15*C* diffuse condensation of the sternum can be seen.

Until now it was quite impossible to know roentgenologically which of the skeletal changes belong to the early stage of disease and which to the late stage. Usually, extensive osteosclerosis was considered to be a feature of the late stages. Vogt reported recently the case histories of 2 osteomyelosclerotic female patients. The knee regions of the first patient, a woman of forty-one, in whom the illness started only a few months ago, showed completely sclerotic bones with normal outlines. Six years later, a follow-up shows stationary findings. On the other hand, the roentgenograms of the knee regions of the second patient, a woman of sixty-seven, in whom the illness started four years ago, reveal that the sclerosis involves only the femur and tibia epiphyseal and metaphyseal region and to a slight degree the patella. A mixed picture is seen in Figure 16, which shows the pelvis of the above-mentioned patient aged forty-one. Areas of mottling in the pubis alternate with diffuse condensation in the region of the linea innominata.

The commonest sites of osteosclerosis are the vertebral bodies, sternum, ribs, pelvis, the proximal regions of humerus, femur and tibia, and the distal region of the femur. There is no regular involvement of the skull in every case. There can be found either spotted sclerosis on the vault of the skull or sometimes also diffuse condensation. The small bones of the hands and feet are very seldom involved.

Osteomyelosclerosis must be differentiated from chronic leukemias, from hemolytic icterus (here the osteosclerosis, however, is limited but to the skull), and from aplastic anemia, in which single cases show osteosclerosis, but no myeloid metaplasia of the spleen. The differentiation from bone involvement in generalized carcinomatosis appears difficult, particularly in the presence of anemia and myeloid splenomegaly; in these cases, however, no myelosclerosis is found. There is absolutely no connection between osteomyelosclerosis and Albers-Schönberg disease. Osteopetrosis is characterized by its onset in earliest life; it is a hereditary disease with frequent spontaneous fractures, and sometimes with atrophy of the optic nerve. There are typical roentgenological appearances in osteopetrosis. The condensation is more uniform, not so scattered as in osteomyelosclerosis, more ribbon-shaped. The characteristic deformities of the long bones frequently observed in marble bones are lacking in osteomyelosclerosis. Furthermore, osteomyelosclerosis must be differentiated from Camurati-Engelmann disease, from hyperostosis generalisata with pachydermia, osteopoikilosis, melorheostosis, fluorine sclerosis and related disorders, osteitis deformans, and Paget's disease.

In conclusion, a few words about the treatment. Irradiation of the spleen has been found to give temporary benefit to patients. Otherwise also, fatal blood crisis (functional agranulocytosis followed by septicemia) after this treatment was observed by several authors (Wolf, Zadek, Lüpschitz, Hecht-Johansen, Johansen and With), so that roentgen therapy is con-

sidered to be contraindicated. Also splenectomy is found to be contraindicated (Bukh and With, Rosenthal and Erf).

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PERICARDIAL CYSTS

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INTRODUCTION

IT IS the purpose of this paper to call the attention of roentgenologists to a group of abnormalities whose characteristic roentgenological feature is a cyst-like shadow inseparable from the heart and pericardium, to organize the information at present scattered throughout many journals into a classification of cysts of the pericardium, and to discuss the important roentgenological aspects of certain of these cysts.

A search through the American roentgenological literature reveals no comprehensive article or bibliography concerning cyst-like shadows inseparable from the heart and pericardium. There are three communications containing case reports[12, 13, 33] in which roentgenological examinations of such abnormal shadows were followed by histopathological study of the pathologic specimens.

The opportunity to observe 5 patients having a cystic shadow inseparable from the heart stimulated interest in the present status of our knowledge concerning this abnormality. These cases were studied in the routine work of a private radiological practice over the past two years and one of the cases was studied by angiocardiography with subsequent removal of the cyst and histopathological study of the specimen.

PATHOLOGY

An analysis of the papers devoted to the pathological anatomy of cyst-like formations inseparable from the pericardium since the fist communication, *An Account of Hernia Pericardii*, by Hart[16] to the present day permits an ordering and classification of the facts.

Hernia of the pericardium[7, 16, 17, 32, 41] and diverticulum of the pericardium[3, 4, 37] were terms used by the Nineteenth Century pathologists in their descriptions of a cyst-like anomaly of the pericardium. They described varying sized protrusions of the serous pericardium through a defect in the fibrous layer of the pericardium. Some structural defect in an otherwise normal fibrous layer of the pericardium permits a portion of the tunica serosa to protrude through the opening in the tunica fibrosa. This forms a diverticulum in the true sense of the word. Diverticulum of the pericardium should be the term reserved for specimens having this anatomical finding.

In recent times there are additional anatomical reports of this anomaly of the pericardium.[5, 18, 29, 33, 35, 44, 45, 52]

Today the thoracic surgeons are repeating *in vivo* the anatomical observations of the early Nineteenth Century pathologists. In 2 surgical case reports of successful removal of a diverticulum of the pericardium published in 1946,[5, 33] two different surgeons independently made an operative note to the effect that the fluid in the diverticulum could be made to disappear from the cystic sac and pass into the main pericardial cavity. Their descriptions of this fact almost read like the original observation by Hart made on a cadaver in the Park-street School of Medicine, Dublin, 1837, " . . . the sac contained fluid to the amount of three or four ounces, and was free and unattached in its whole extent, except at its upper and smaller extremity, where there existed a free communication between it and the pericardium, as proved by the following simple experiment:—By raising the sac off the pericardium, it was made to empty itself, the fluid passing into, and increasing the already distended condition of that sac; and again, on pressing on the pericardium from below upwards, the abnormal sac, in its turn, assumed its former dilated appearance."[16]

The term congenital pericardial cyst[11, 30, 49] designates a unilocular, endothelial-lined cyst with paper-thin walls and no inflam-

matory changes which is held to be of congenital origin. Lambert[26] coined the term "pericardial celomic cysts" and first suggested that these cysts result from an anomalous development of the pericardium. Since the pericardial celom develops in embryo by the fusion of multiple disconnected mesenchymal lacunae, if one of the lacunar cavities failed to merge with the others it could persist and develop into a pericardial celomic cyst. This is a plausible embryological explanation which has been rather generally accepted by clinical workers.[24,25,47]

Lambert also pointed out that these cysts are lined with vascular endothelial cells lying upon loose fibrous tissue containing capillaries. He supported his theory of their origin by noting that it is difficult histologically to distinguish between mesothelial and endothelial cells in the lining of the cysts. According to this author, all other cysts in the anterior mediastinum have definite histological characteristics to distinguish them, but the celomic cysts are of the simplest structure, being extremely thin, unilocular sacs lined with vascular endothelium (mesothelium?) and containing a thin fluid usually clear but occasionally sanguineous.

Lambert's term, pericardial celomic cyst, refers to the embryological origin (pericardial celom) of a histopathological type of thoracic cyst described above. The cases reported by him do not arise from the pericardium but are thin-walled thoracic cysts in the anterior mediastinal-diaphragmatic angle, definitely extrapleural in origin and often adjacent to the pericardium. The case reported by Lam[25] was just anterior to the pericardium but fastened closely to it. It was stripped from the pericardium rather easily at operation. Pickhardt[39] removed such a cyst from the region of the diaphragm and pericardium. In 1926 (fourteen years before Lambert's terminology) Windholz[49] described the gross and microscopic pathology of a cyst found in the mediastinum just anterior to the pericardium and having all of Lambert's criteria of a pericardial celomic cyst.

It should be possible for a pericardial celomic cyst to arise from the pericardium itself and in reviewing the literature on the pathological anatomy of pericardial cysts for this paper the writer found an autopsy report of just such a specimen. In 1928 Eliaschewitsch[11] reported a cyst found at autopsy on a thirty year old patient, dead of endocarditis. It was located on the posterior surface of the left auricle, "nut-sized," round and connected by a stalk with the epicardium. The author states, "Our cyst does not lie outside the pericardial sac as in a diverticulum of the pericardium but it is hanging within the pericardial sac on a stalk." His description continues, " . . . diverticulum of the pericardium has a cell structure similar to that of the pericardium while our case showed a difference—a unilocular sac with a thin wall, lined with endothelial cells and showing many fibroblasts in the inner layer. A thin serous fluid containing only a few small coagulated albumen particles was inside the cyst."

Another set of terms is applied to those cysts which may be found inseparable from the pericardium and which arise from the lymphatic elements in the pericardium itself or from these elements in structures adjacent to the pericardium. These terms are: intrathoracic cystic lymphangioma, hygroma cysticum, spring-water cyst, and lymphangiomatous cyst, and refer to multilocular cystic tumors (lined with endothelial cells and containing varying numbers of lymphocytes) which retain embryonic power of irregular growth and which may arise anywhere within the thorax. Their structure is more complicated than the celomic cyst. In the lymphangiomatous cyst, the walls are of varying thickness, the cyst is multilocular and contains scattered collections of fat cells, foci of lymphocytes, blood vessels and occasionally small muscle fibers.

In the beautiful monograph by Aagaard[1] on the lymphatic vessels of the heart, one will find the most complete anatomical data on the distribution and arrangement of the

cardiac and pericardial lymph channels and lymphatic elements. Lymphangiomatous cysts arising directly from the pericardium have been reported by Dufour and Mourrut,[10] Lenkeit,[31] and Yater.[51]

There have been numerous cases reported in the surgical literature in which the lymphangiomatous cysts were found adjacent to the pericardium in the anterior mediastinum but did not have their origin within the pericardium.[24,46,47] In all, some 16 anterior mediastinal lymphangiomas have been reported by the thoracic surgeons.[47]

Of recent years, the terms inflammatory diverticulum of the pericardium and inflammatory pulsion diverticulum of the pericardium have come to have a single general meaning and to specify a pseudocyst formation resulting from chronic exudative pericarditis.[6,12,23,28,30,40] Here a localized exudate formation in a portion of the pericardium not obliterated by inflammatory changes causes a pouch of the pericardium to stretch or herniate through the adjacent pericardial scar tissue and pericardial adhesions. This pseudocyst formation may consist of only the serous layer of the pericardium bulging through an opening in the diseased fibrous capsule or it may involve all the layers of the pericardium, just as a pulsion diverticulum of the esophagus stretches all layers of the esophagus, hence the name "inflammatory pulsion diverticulum of the pericardium."[12,30]

As regards other pathologic types of pericardial cyst to be found in the literature, Joël[21] was the first to record a teratomatous cyst limited to the pericardium. Lenkeit,[31] Grimm,[13] and Jellen and Fisher[20] have reported cases of teratomatous cysts of the pericardium.

Dévé, the first and foremost authority on echinococcus disease in man, reported upon secondary echinococcus cyst of the pericardium in his inaugural thesis at Paris in 1901. In 1915 he again called attention to the anatomical and clinical aspects of such cysts in the pericardium.[8] Mönckeberg[34] reports cysticerci as well as echinococcus cysts in the pericardial sac.

Perlstein,[38] in a thorough study of the literature on primary sarcoma of the heart up to 1918, details 30 cases of this rarity from the world literature and 8 of these were primary in the pericardium and 4 of the 8 had large cyst formations. This author also added a case of primary sarcoma of the pericardium and much of the very large tumor in his case was cystic. More recently, in 1929, pericardial cyst based upon cystic degeneration of primary malignancy of the pericardium is discussed by Lenk,[30] with report of a case.

Wright[50] reported a case of cyst of the pericardium with a calcified border and about the size of a tangerine. The cyst was successfully removed and histopathological study showed it to be a blood cyst between layers of the parietal pericardium. It was believed to be of traumatic origin as there was a history of a severe blow over the patient's precordium from a hockey ball seven years before the surgical operation.

A pericardial cyst of sufficient size and weight to compress the pulmonary artery and cause the death of the patient under the signs and symptoms of pulmonary embolism is reported by Nossen.[36] The patient, a female aged fifty-one, had died on the sixth day after an automobile accident in which she had suffered a fractured hip. The fracture was reduced at surgical operation under a general anesthetic and the patient had the sudden death mentioned above on the third postoperative day. The finding of the large pericardial cyst at autopsy came as a complete surprise. The cyst contained much fresh blood, and histopathological examination showed it to be composed of bronchial tissue—a tracheobronchial cyst limited entirely to the pericardium.

Thus, from data in the literature, we may make a classification of cysts of the pericardium, show the pathologic anatomy reported in the different types of cysts, and list the frequently used synonyms applied to these cysts (Table 1).

TABLE I

A CLASSIFICATION OF PERICARDIAL CYSTS

Type	Pathologic Anatomy	Synonyms
TRUE CYSTS		
Congenital Pericardial celomic cyst	Unilocular, thin-walled cyst lined with mesothelium. Anomalous development of pericardial celom (mesoderm) Lambert (1940)	Thin-walled pericardial cyst. Congenital pericardial cyst. Pericardial celomic cyst.
Cystic lymphangioma	Multilocular cystic tumor originating in pericardial lymphatic nests (mesoderm) Lenkeit (1928)	Intrathoracic cystic lymphangioma. Hygroma cysticum. Spring-water cyst. Lymphangiomatous cyst.
Bronchial cyst	Cystic tumor arising in pericardium from bronchial anlage (endoderm and mesoderm) Nossen (1925)	
Teratoma	Pericardial tumor with varying cystic properties but containing by definition ectodermic, mesodermic and endodermic elements Joël (1890)	
Acquired Cystic hematoma	Cyst resulting from degenerative changes in a pericardial hematoma Wright (1936)	
Neoplastic cyst	Cyst due to degeneration of a solid tumor in pericardium Perlstein (1918)	
Parasitic cyst	Cyst produced by cysticerci ortaenia echinococcus in pericardial sac Dévé (1901) Mönckeberg (1924)	
PSEUDOCYSTS		
Pericardial diverticulum	Serous layer of pericardium pushes through a weak spot in fibrous layer forming a sac communicating with pericardial cavity. This herniation is result of some structural weakness of tunica fibrosa. Hart (1837)	Diverticulum of the pericardium. Hernia of the pericardium.
Encapsulated pericardial exudate	Csyt-like formation as a pouch of pericardium is pushed through pericardial scar tissue and adhesions in cases of chronic exudative pericarditis. As localized exudate in pouch accumulates the pouch enlarges by stretching. Kienböck and Weiss (1929)	Inflammatory diverticulum of the pericardium. Inflammatory pulsion diverticulum of the pericardium.

REPORT OF CASES

Case 1. Mrs. G. S., white, aged fifty, was referred for roentgenological examination by her chest physician on January 16, 1948. She had had a photofluorographic chest film made during an Indiana State Board of Health chest survey in her home city in August, 1947. The 70 mm. film (Fig. 1) demonstrated an abnormal heart shadow with a questionable tumor shadow in the lower right lung. The essential points of her clinical record are as follows:

Fig. 1. Case 1. 70 mm. photofluorogram taken in August, 1947.

Present History. Her chief complaint was nervousness and irritability. Since June, 1947, she had had occasional left lower chest pain and occasional faintness but no syncope. She had noticed slight palpitation and slight dyspnea on exertion. There was no cough, orthopnea or hemoptysis.

Past History. The patient had a tonsillectomy at the age of thirty, appendectomy at thirty-five, and vaginal hysterectomy at forty-six. The patient has 6 children living and well.

Family History. Her mother died at the age of sixty-four of "heart disease." Her father died at the age of sixty-seven of "cancer of the stomach." Six sisters and 1 brother are living and well.

Physical Examination. The patient was a well developed and well nourished woman. Head: normal; ocular fundi, negative. Neck: the thyroid was palpable but not enlarged. No glands were palpable and the veins were not distended. Chest: the breasts were normal. There was slight dullness in the lower right chest anteriorly. The chest was otherwise not unusual. Heart: there was no cardiac enlargement, no thrills or murmurs. The rhythm was regular and the sounds were of good quality. Abdomen: no masses or tenderness noted. Pelvis: there was a cystocele and rectocele. Rectum: normal. Extremities: there was a cystic swelling on the dorsum of the left hand. There was a nodular mass on the dorsum of the left third finger over the proximal interphalangeal joint. There was a firm nodular mass on the dorsum of the right forearm just below the elbow.

Laboratory Data. The urinalysis was normal. Complete blood count was normal. Serology was negative. Basal metabolic rate reports were plus 13 per cent, plus 16 per cent. Electrocardiogram (including CF 2, 4, 5) showed no abnormality. Histopathological study of biopsy of the tumor from the left third finger showed "inflammatory synovial tissue"; biopsy report from the tumor below the left elbow showed "granulomatous mass, resembling juxta-articular masses seen in rheumatoid arthritis."

Roentgen Examination of Chest. This included films made with the patient in the posteroanterior, right oblique and left oblique positions (Fig. 2, 3 and 4). Roentgenoscopy and roentgen kymography (Fig. 5) were done. The roentgen report was as follows: "There is a large shadow of increased density continuous with the right heart border and overlying the right ventricle of the heart. In the right lateral and right anterior oblique projections a somewhat oval, cyst-like portion of the larger anterior density seems to project backward from the cardiac silhouette. The left heart border is not enlarged. The great vessel shadows are normal. At roentgenoscopy there was no expansile pulsation of the shadow along the right heart border and there was no change noted

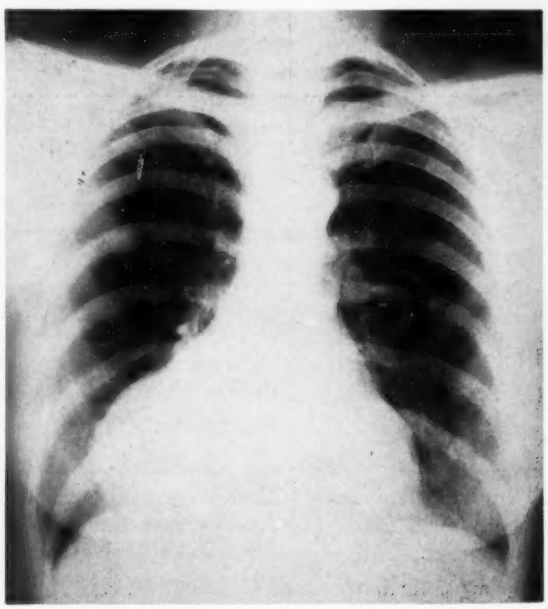

Fig. 2. Case 1. Bucky chest roentgenogram taken January 16, 1948. The abnormal right heart border and normal left heart border are shown.

in the length or breadth of the shadow on deep inspiration and expiration. The roentgen kymogram suggested transmitted pulsation only in the region of the mass. Impression: The shadow is consistent with anterior mediastinal cyst inseparable from the anterior and right lateral portions of the heart."

On October 30, 1948, the patient submitted to angiocardiographic studies. These films (two of which are reproduced in Fig. 6 and 7) very clearly outline the intimate contact of the cyst margins with the right auricle and right ventricle of the heart. After this examination the roentgen impression was "possible pericardial cyst."

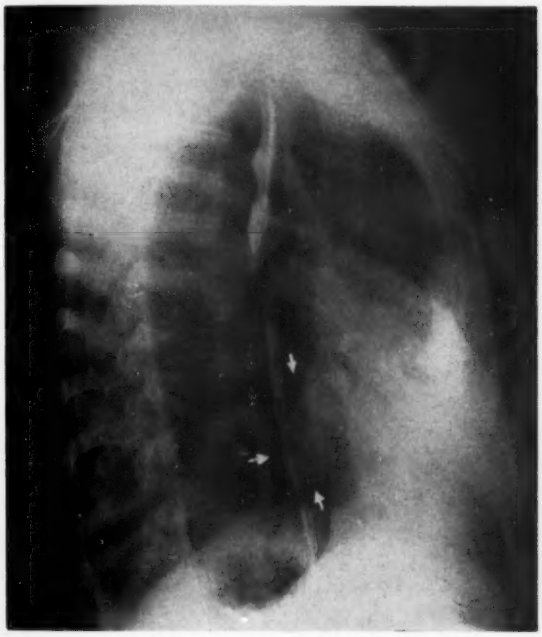

Fig. 3. Case 1. Right anterior oblique chest roentgenogram. Arrow points to lobulated cystic shadow in retrocardiac space. At roentgenoscopy it is inseparable from the density shown here overlying most of the heart shadow.

From January, 1948, until February, 1949, the patient carried on her usual household duties but reported to her physician that she seemed to have precordial chest pain more frequently and that spells of palpitation occurred more often, especially when lying down. She elected to undergo surgical operation for removal of the cyst and was operated upon June 28, 1949.

The operative report by the surgeon is as follows: "Under intratracheal, nitrous oxide-

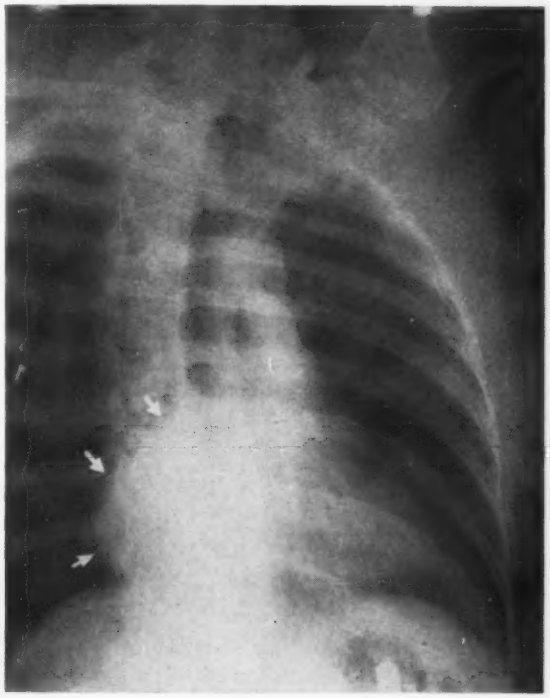

Fig. 4. Case 1. Left anterior oblique projection of the chest. Arrows point to margins of saccular density overlying right half of heart shadow.

Fig. 5. Case 1. Roentgen kymogram. Arrow points to transmitted pulsations on right heart border.

Fig. 6. Case 1. First exposure of angiocardiographic examination. The opacification of the superior vena cava and right auricle is shown. The absence of opaque medium in the abnormal shadow is noted.

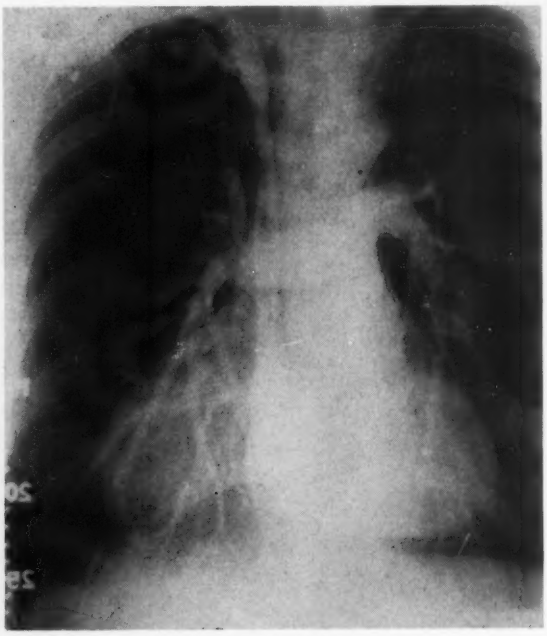

Fig. 7. Case 1. Second exposure of angiocardiographic examination. There is opacification of the superior vena cava, right auricle, right ventricle, and pulmonary outflow tract with no opaque medium in the abnormal shadow.

oxygen anesthesia supplemented with pentothal sodium and curare, a postero-lateral incision was made in the 7th interspace. The ribs were separated and a large cyst was easily identified. It measured roughly 6 by 5 inches in its two diameters. After the mediastinal pleura was incised, the cyst was found attached to the pericardium over the right ventricle, right auricle and right inferior pulmonary vein. The cyst was separated from the pericardium by sharp and blunt dissection and gently stripped from the right inferior pulmonary vein. The entire cyst was removed en masse, raw surfaces were covered, the lung inflated and the chest closed without drainage . . . 200,000 units of penicillin were left in the chest. Note: Biopsy showed the cyst wall to be endothelial tissue with regular cells."

Pathology Report. "The specimen consists of a cyst removed from the pericardium. This

Fig. 8. Case 1. Surgical specimen removed at operation on June 28, 1949.

cyst measures, after it has been collapsed, 13 by 9 by 1 cm. It is one large cyst with several smaller cyst formations. The walls of these cysts were very thin. No tumor or nodule formation was seen in the wall." (The gross specimen is shown in Figure 8.) "Microscopic study: Section through the wall of the cyst shows the structure to be chiefly that of fatty tissue, along with some fibrous elements. There appears, in certain regions, a lining endothelium of flat cells, all regular in appearance. There is lymphocytic infiltration throughout the tissue. More representative sections secured from the specimen showed the heavier portion of the

cyst wall to contain numerous sinuses of lymphatic origin. Diagnosis: Lymphangiomatous cyst of the pericardium." (Fig. 9 shows a representative microscopic section.)

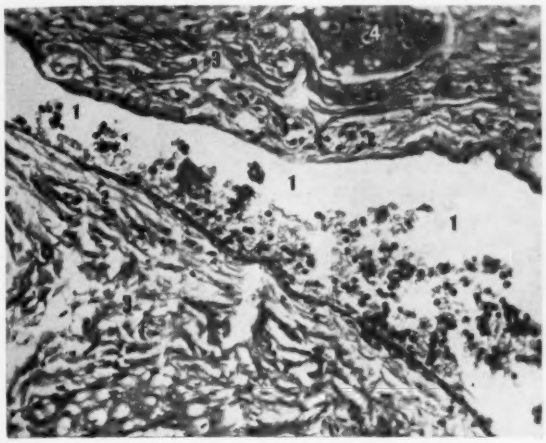

Fig. 9. Case 1. Photomicrograph of section from specimen shown in Figure 8. (*1*) Large lymph sinus with coagulated protein and lymphocytes. (*2*) Endothelial cells lining the sinus. (*3*) Connective tissue stroma. (*4*) A second smaller endothelial-lined space containing protein and lymphocytes.

Follow-up Report. Figure 10 is a chest roentgenogram of this patient one month after her discharge from the hospital. On November 15, 1949, the patient reports that she is well and free of the precordial distress and palpitation she complained of before the operation.

Case II. J. W., a former coal-miner, aged fifty-three, was referred on April 12, 1949, for roentgenological study of the chest. The patient had been referred with a provisional diagnosis of extrapulmonary tumor, and had had roentgenological examination, including bronchography, in another Indiana city. These previous studies included posteroanterior and right lateral chest roentgenograms made February 15, 1949, at which time he was ill with a virus pneumonia. In addition to the pneumonitis in the right lower lung, the roentgen report at that time included a description of a rather circumscribed oval shadow in the midmediastinum just posterior to the heart. After recovery from the pneumonia, a bronchographic examination of the right lung was done on March 22, 1949. The oval mediastinal shadow was stated to be the same size as on the previous examination, and the lipiodol outlined normal bronchi and no opaque medium was

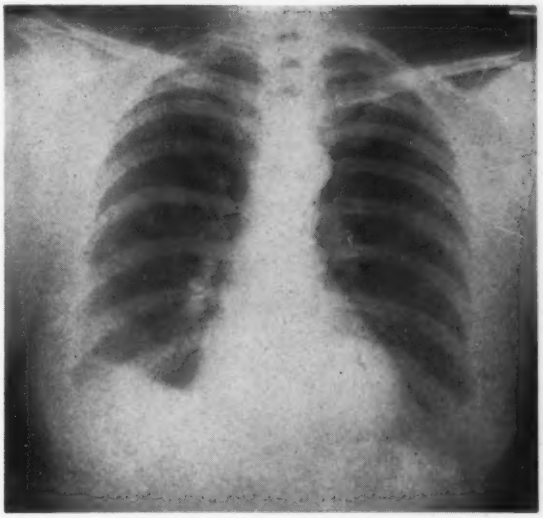

Fig. 10. Case 1. Postoperative chest roentgenogram. There is some pleural thickening in right costophrenic sinus and along right diaphragm after surgery.

shown within the oval shadow. His physicians carried out bronchoscopic examination which was reported as entirely negative.

On April 12, 1949 the spot roentgenograms shown in Figures 11 and 12 were made at roentgenoscopic examination. Roentgenoscopy showed some residual lipiodol in the base of the right lung. The lung fields were otherwise not unusual. The esophagus was normal when outlined with barium paste. The heart size and its pulsations were normal. However, there was a sharply defined, lobular, cyst-like shadow on the right heart border. It was seen best in the right anterior oblique position, and its margins both above and below became inseparable from the cardiac silhouette. It appeared to be on the anterolateral surface of the right auricle. The cyst wall was thin and without calcification. It did not change its shape on inspiration and expiration. It did not pulsate. It was attached to the cardiac border by a rather wide base and there was no pedicle shadow extending into the hilus. The shadow did not disappear or decrease in size with the patient in the Trendelenburg position. The diaphragm was normal and the cyst shadow made no contact with the right diaphragm.

The roentgen impression was: "thin-walled pericardial cyst over the anterior and lateral portions of the right auricle."

The patient had no clinical symptoms at the time of this examination. Because of the absence

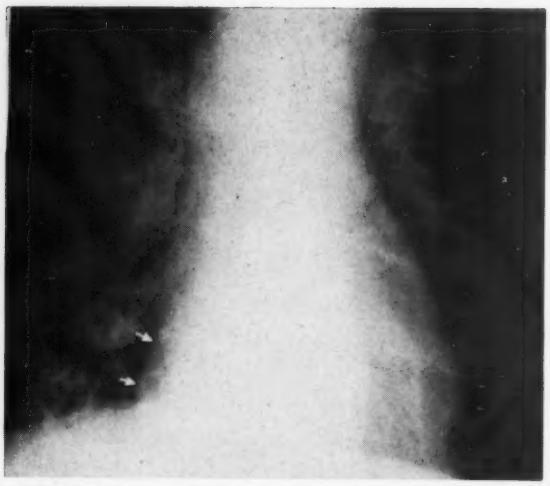

Fig. 11. Case II. Spot film made at roentgenoscopy on April 12, 1949. Residual lipiodol in right base. Arrow points to margin of cyst-like shadow in right cardiophrenic angle.

Fig. 12. Case II. Right anterior oblique spot film made at roentgenoscopy on April 12, 1949. Arrows point to margins of the cyst inseparable from heart and pericardium. Upper arrow points to its attachment to pericardium over right auricle. Residual lipidol in lower right lung superimposed on cyst shadow.

of any symptoms or physical signs and the demonstration that the shadow so long in question was probably a pericardial cyst, surgery was not deemed necessary and the patient was returned to his home. He was advised to have semi-annual roentgenological chest studies to detect any important increase in the size of the cyst.

Case III. Dr. W. K., male, dentist, aged fifty, had suffered a severe coronary occlusion January 12, 1947, for which he was hospitalized. The cardiac diagnosis confirmed by electrocardiographic examination and complete clinical studies at that time was coronary occlusion with myocardial infarction, posterior wall left ventricle. He was discharged from the hospital April 4, 1947, and convalescence was completed at home. On June 1, 1947, the patient was allowed an hour of work a day at his office. With graded increase in physical activity he was back to regular office hours by November 15, 1947. He was referred for a chest roentgenogram on May 3, 1947 (Fig. 13). This showed some increase in the size of the left heart and no evidence of pulmonary disease.

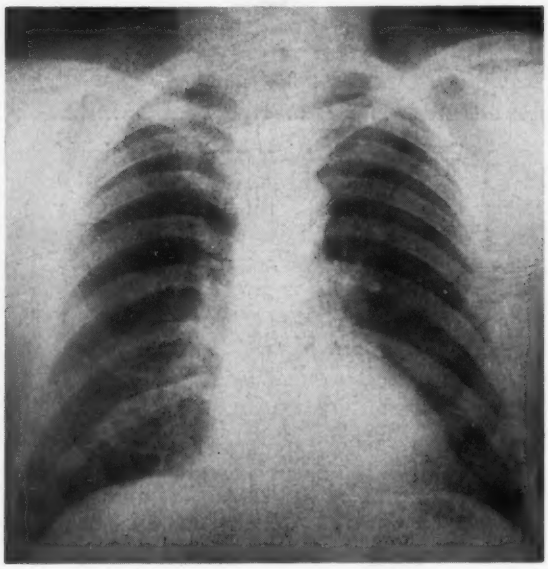

Fig. 13. Case III. Chest roentgenogram made on January 1, 1948. The lower left lung field is normal.

His physician reports that the patient was treated in the home from December 6, 1947, to January 1, 1948, for virus pneumonia. He had a fever which never exceeded 101° F. for six days of this time. His infection responded to aureomycin medication. There was some lower anterior left chest pain during this illness but no pericardial or pleural friction rub was heard.

A chest roentgenogram was made shortly after convalescence from this episode and demonstrated slight peribronchial haziness in the lower left lung field. The heart appeared a little larger on this examination.

On June 2, 1949, the patient had a routine chest study as part of his periodic cardiac

check-up. Figure 14 (two and a half years after the coronary occlusion and one and a half years after the virus pneumonia) shows the

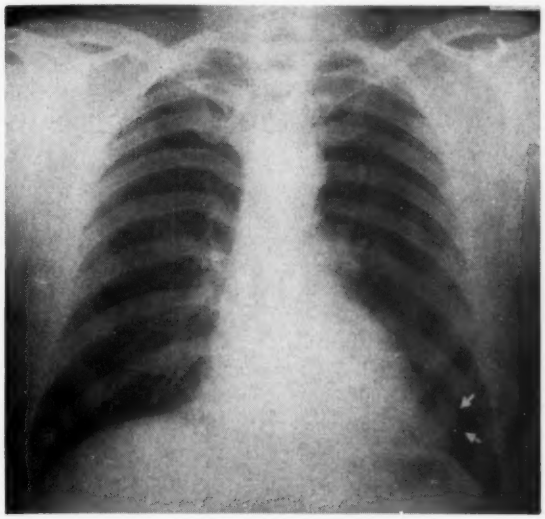

Fig. 14. Case III. Chest roentgenogram made June 2, 1949. Arrow points to circumscribed annular shadow above the left hemidiaphragm and adjacent to cardiac apex.

appearance of the heart and lung fields at this time. There had been no change in the size of the heart, but a circumscribed, almost annular density was seen just above the dome of the left diaphragm adjacent to the cardiac apex. The patient had no unusual symptoms and had been symptom free for over one year.

Roentgenoscopy of the chest and heart showed the true location of the shadow just above the left diaphragm. It was inseparable from the pericardium at the apex of the heart, seemed saccular and appeared attached only to the apical portion of the pericardium. There were *no* strands or pleural bands on the peripheral surface of this shadow connecting it with the pleura of the anterior chest wall or diaphragm. The shadow did not pulsate. A spot roentgenogram made at roentgenoscopy is shown in Figure 15. With every change in position of the patient the appearance of this shadow remained exactly as shown in Figure 15.

The roentgen impression was: "small pericardial cyst inseparable from the heart and pericardium at the apex."

The cyst-like shadow demonstrated in this case is almost identical in location and size to the lymphatic cyst proved at autopsy in the case reported by Yater.[51] In Yater's case the

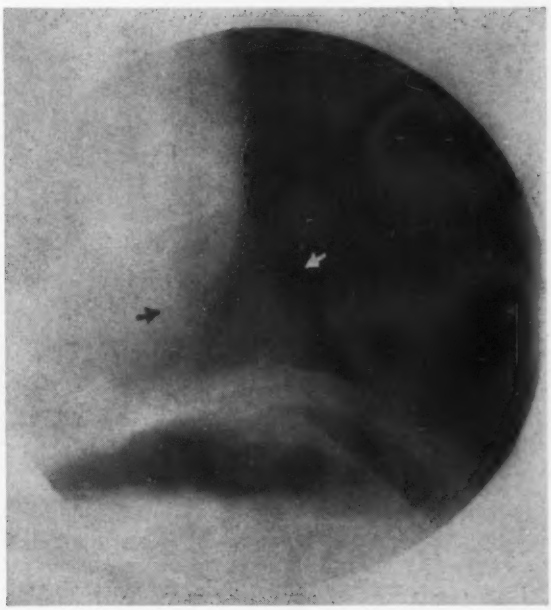

Fig. 15. Case III. Upright spot film made at roentgoenoscopy on June 2, 1949. The attachment of the annular shadow to the apical pericardium is shown.

annular shadow was mistaken for a nodular metastasis in the left lower lung field (his patient was known to have adenocarcinoma of the stomach). Yater reports that the annular shadow was seen only on a chest roentgenogram and roentgenoscopic study of this shadow was not done.

Case IV. Mrs. M. G., aged fifty, a technician in a pharmaceutical supply house, was referred for chest roentgenogram on July 22, 1949. The patient had received a report from a photofluorographic film taken during a recent municipal chest survey that her heart was abnormally large.

Her past medical history included typhoid fever at eleven years of age, diphtheria at twenty-two, and a mastoidectomy at thirty-seven. The patient had absolutely no symptoms at the time of the present examination. There were no cardiac findings on physical examination by the referring physician. The blood pressure was normal.

The chest roentgenogram (Fig. 16) showed a transverse type heart with a prominent right heart border. The aortic arch was on the left and of normal size. There was no evidence of pulmonary disease and the diaphragm was normal.

Roentgenoscopy of the chest and heart

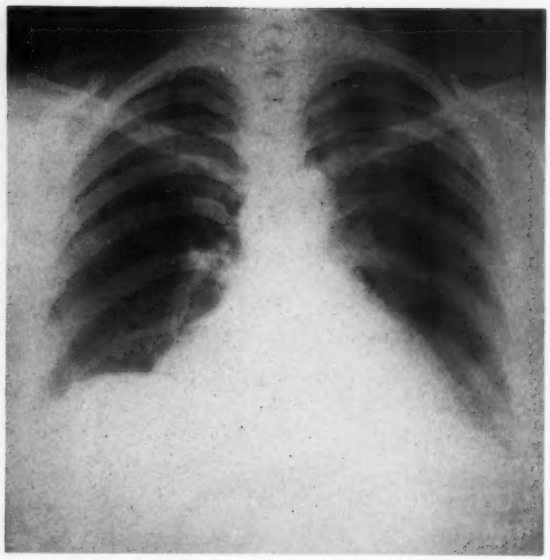

Fig. 16. Case iv. July 22, 1949. Chest roentgenogram showing an apparently enlarged right heart border.

showed a cystic shadow occupying the right cardiophrenic angle and inseparable from the right heart border. On deep inspiration, the circumscribed border of the cyst shadow was noted as the diaphragm on the right descended away from the saccular lower border of the shadow. A spot film of this roentgenoscopic observation is shown in Figure 17. In slight right posterior oblique positioning of the patient, the medial border of the cystic shadow was identified and there was a questionable pedicle shadow which appeared to emerge from the surface of the right auricle. Figure 18 illustrates this observation recorded on a spot film. The impression was: "cyst-like shadow inseparable from the right auricular portion of the heart and pericardium." It was requested that the patient return semi-annually for roentgenoscopic study to detect any change in the cyst.

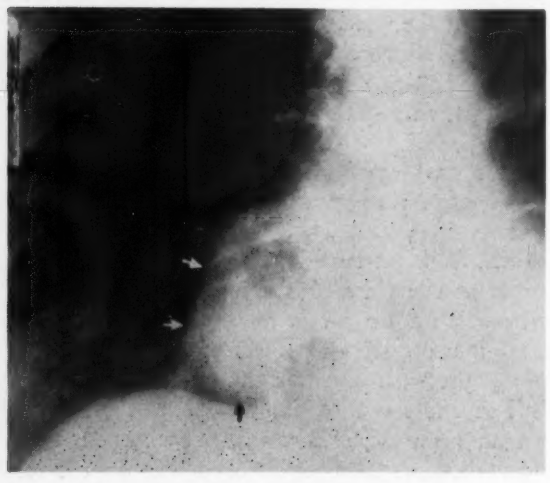

Fig. 17. Case iv. Posteroanterior spot film made at roentgenoscopy during deep inspiration reveals the sharp margins of cyst-like shadow attached to the heart on the lower right heart border.

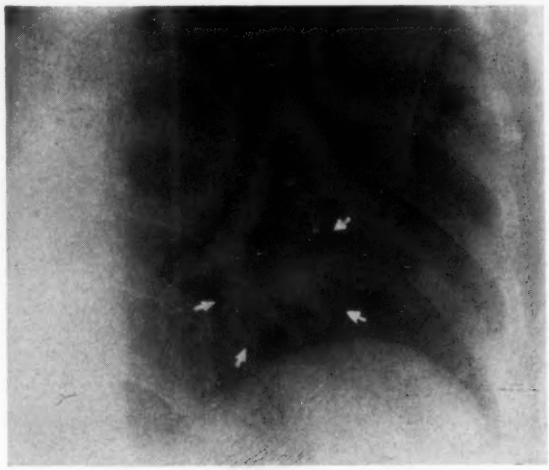

Fig. 18. Case iv. Spot film made at roentgenoscopy. Slight right posterior oblique position of patient. Film made on deep inspiration. The medial border of cyst shadow is shown better than in Figure 17.

On January 16, 1950, almost six months later, the patient returned. She still felt perfectly well and had noted no symptoms of any kind during the interval between examinations. Roentgenoscopy revealed no change in the size of the cyst shadow since the last observation. The spot film made for the record is shown in Figure 19*A*. Because no observation concerning change in size of the shadow with change in position of the patient was made at the first examination this procedure was carried out. Figure 19*B* and *C* are spot films made at roentgenoscopy with the patient horizontal and in the Trendelenburg position, respectively. The films are all posteroanterior projections with the spot film device at the same position against the lower right thorax, and all are made on deep inspiration. A definite decrease in the size of the shadow with the patient horizontal and its disappearance in Trendelenburg position is noted when compared with the film made upright (Fig. 19*A*). The "empty sack" appearance of the shadow is evident when compared with the upright film.

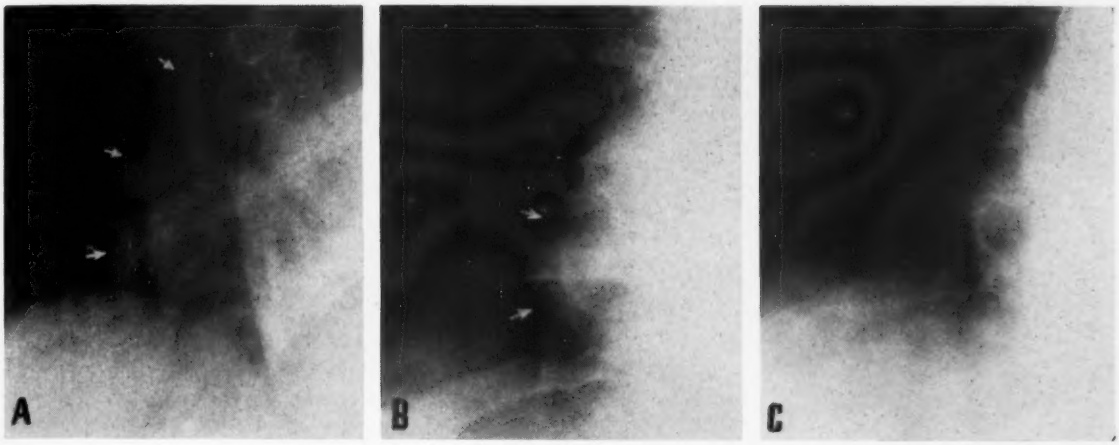

Fig. 19. Case iv. (*A*) Upright spot film made at roentgenoscopy on January 16, 1950. No change in size of cyst-like shadow since last examination. (*B*) Spot film made with patient horizontal. (*C*) Spot film made in Trendelenburg position. All films made on deep inspiration and with spot film device at some location on anterior right chest wall. The "empty sack" appearance of the cyst shadow in the horizontal and Trendelenburg position is shown.

The roentgenological impression after this observation was: "probable true diverticulum of the pericardium on the right auricle."

Case v. Mrs. H. M., aged seventy-five, was sent for roentgenological study of the gastrointestinal tract on June 24, 1949. She had no chest or cardiac symptoms and the examination of the stomach and colon was ordered as part of a complete medical examination. The gastrointestinal study demonstrated a normal stomach and duodenum, and the barium enema revealed only a large solitary diverticulum of the upper ascending colon.

During the roentgenoscopy of the chest at the time of the gastrointestinal examination, an unusual shadow was noted along the upper left heart border. It was circumscribed and did not pulsate. It appeared to emerge from the left hilus and upper left atrium by a pedicle-

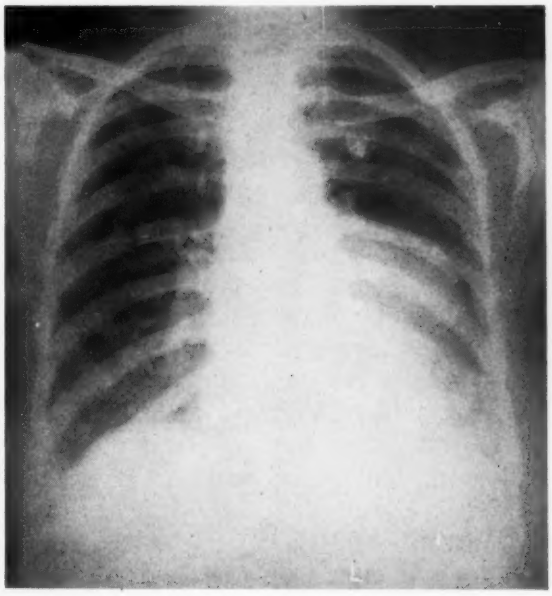

Fig. 20. Case v. Chest roentgenogram made June 24, 1949. Cyst-like shadow along left upper heart border which seems to emerge from the left hilus.

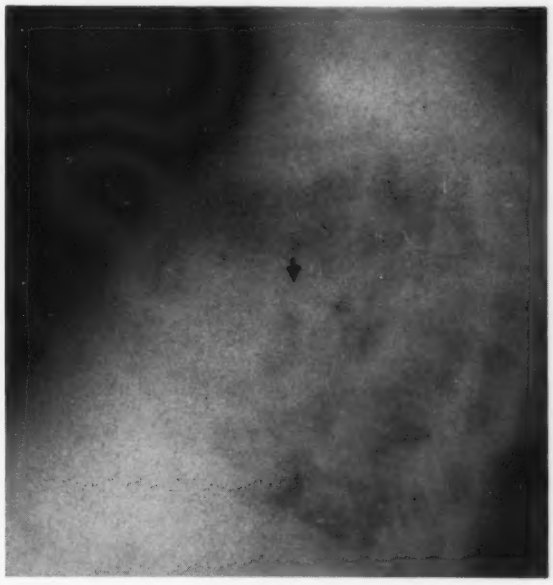

Fig. 21. Case v. Left lateral chest roentgenogram made June 24, 1949. Arrow points to pedicle shadow at left hilus.

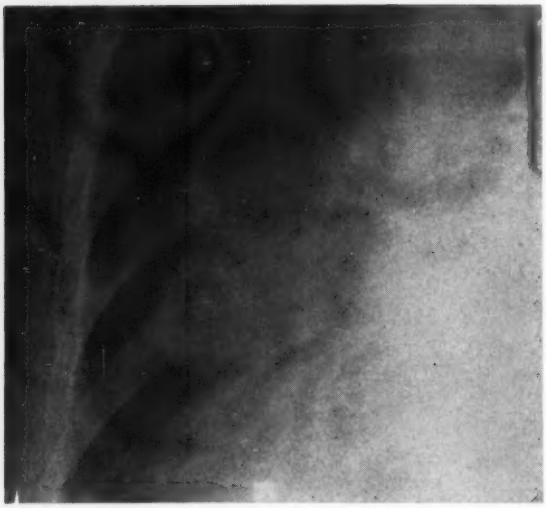

Fig. 22. Case v. Spot film made at roentgenoscopy on June 24, 1949. Patient in slight left posterior oblique position; margins of cyst-like shadow and upper border of pedicle are shown.

like shadow and the sac, somewhat less dense than the cardiac silhouette, seemed more radiolucent in its periphery. It did not change its size or shape with respiration or with the patient in marked Trendelenburg position. Figures 20, 21 and 22 show the cyst-like shadow in

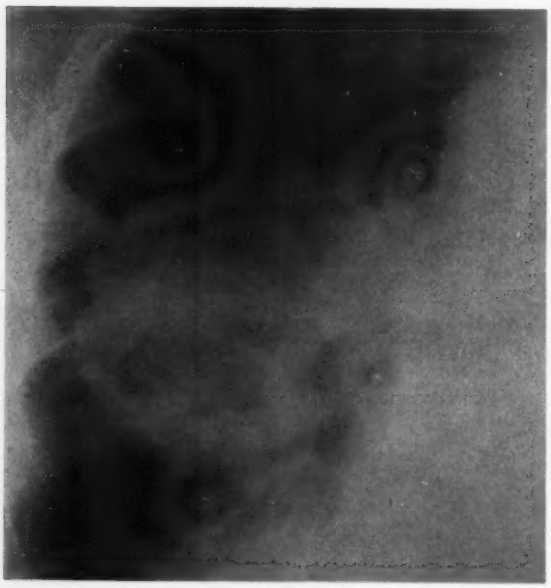

Fig. 23. Case v. Upright spot film made at roentgenoscopy on January 18, 1950. There has been no change in the size of the cystic shadow. Patient in slight left posterior oblique postion as in Figure 22.

posteroanterior, left lateral, and slight left posterior oblique projections, respectively. Figure 22 is a spot film made at roentgenoscopy. The remainder of the heart showed moderate enlargement of the left ventricle. There was calcification in the aortic arch.

Because of the definite stalk-like shadow emerging from the left hilus and continuous with the margins of the sac, the impression was: "probable diverticulum of the pericardium."

Follow-up Examination. The patient was again observed January 18, 1950, seven months after the first study. She had no symptoms of any kind. The size of the cystic shadow had not changed (Fig. 23).

ROENTGENOLOGICAL ASPECTS

The roentgenological aspects of only those cysts of the pericardium known to give rise to thin-walled, relatively radiolucent, saccular shadows inseparable from the heart, *viz.*, lymphangiomatous cyst, true diverticulum of the pericardium and inflammatory diverticulum of the pericardium (Table 1) will be discussed here.

Seidler[45] in 1921 was the first to report a case of benign pericardial cyst studied roentgenologically and histopathologically. The clinical and autopsy data in Seidler's case are summarized as follows: The patient was a male, aged sixty-three, syphilitic, with aortic insufficiency, arterial hypertension and acute nephritis. Roentgenologically the heart was large and showed a spherical shadow inseparable from that of the heart in the region of the right auricle. The shadow projected outward from the right auricular border in the right anterior oblique position. The patient died of a cerebrovascular accident and the autopsy revealed besides generalized arteriosclerosis particularly marked in the heart and kidneys, a large hydropericardium with a circumscribed pocket containing pericardial fluid. The sac or pocket was the size of a hen's egg and lay along the right heart border and over the right auricle.

This case would be classified according to Table 1 of this paper as a true diverticulum of the pericardium under the category of Pseudocysts. The hydropericardium was

probably an important factor in producing the diverticulum.

Since 1921 a considerable number of patients showing cyst-like shadows inseparable from the heart have been studied roentgenologically but without pathologic verification at surgery or autopsy.[2,6,9,14,15,19,23,27,30,40,48]

Since the advent of the roentgen method there are reports of 11 specimens of the anatomic type we are discussing in this section which have been studied roentgenologically *and* histopathologically.[5,12,18,22,23,33,40,44,45,51]

Diagnosis

The roentgenologic diagnosis of pericardial lymphatic cyst, true diverticulum of the pericardium and inflammatory pericardial diverticulum rests upon the demonstration of a mass associated with the cardiac silhouette and inseparable from it in all roentgenoscopic and roentgenographic positions of the patient. The shadow of the mass is usually a well defined, circumscribed, smooth, round or ovoid shadow adjacent to the right or left border of the heart.

The shadow does not change its size rapidly. The cyst formation increases its volume only very slowly, as shown in successive films made over long intervals of time.

The density of the shadow may be identical with the opacity of the heart shadow itself, but in observing the shadow in different positions of the patient *during roentgenoscopy*, some portion of the shadow will usually be less dense than the cardiac shadow and give the impression of a flaccid sac containing fluid. It often appears to hang beside the cardiac shadow without being a component part of the heart.

These abnormal shadows are usually incidental findings and only occasionally do these lesions produce symptoms. When they are of the type found in connection with chronic exudative pericarditis, *i.e.*, inflammatory pericardial diverticula, they coexist with a serious clinicopathological picture having an important pericardial aspect. In these instances pericardial calcification of varying degree *may* be demonstrated adjacent to the cyst-like shadow. Also inflammatory changes may distort the margins of the herniated inflammatory diverticulum so that its contour may be irregular and more polyhedral than circular or ovoid.

Jansson[19] was the first to emphasize the change in shape of a cystic shadow inseparable from the pericardium during the phases of respiration. His roentgenologic study of a young apparently normal girl, aged fifteen, showed a tumor shadow inseparable from the heart. There was no noticeable change in size of this shadow over a long period of time. During deep inspiration it became long and narrow and during expiration it became rounder, shorter and broader. The whole shadow gave the impression of something soft, plastic and capable of modification simply by breathing. These signs, Jansson maintained, would be against the supposition that the density represented a solid tumor formation. This sign may be present in cases of inflammatory diverticulum of the pericardium,[12,40] dermoid cyst of the mediastinum,[40] and pericardial celomic cyst of the anterior mediastinum.[25]

The sign when present helps to ascertain that the shadow in question is possibly pericardial as the lengthening and broadening of the shadow on inspiration and expiration are due to the stretching and relaxing effect of the mediastinal pleura.

The shadow of a true diverticulum of the pericardium may have an elongated, stalk-like portion or neck extending into either hilar region. This pedicle shadow will be of the same density as the rest of the cyst shadow and will give the impression that it emerges from the hilus. This shadow is mentioned in the case reported by Donzelot *et al.*[9] and is well illustrated in Case v of the present report.

It is presumed that the demonstration of a pedicle shadow supports the possibility that a pericardial cyst with this shadow present is a true diverticulum of the peri-

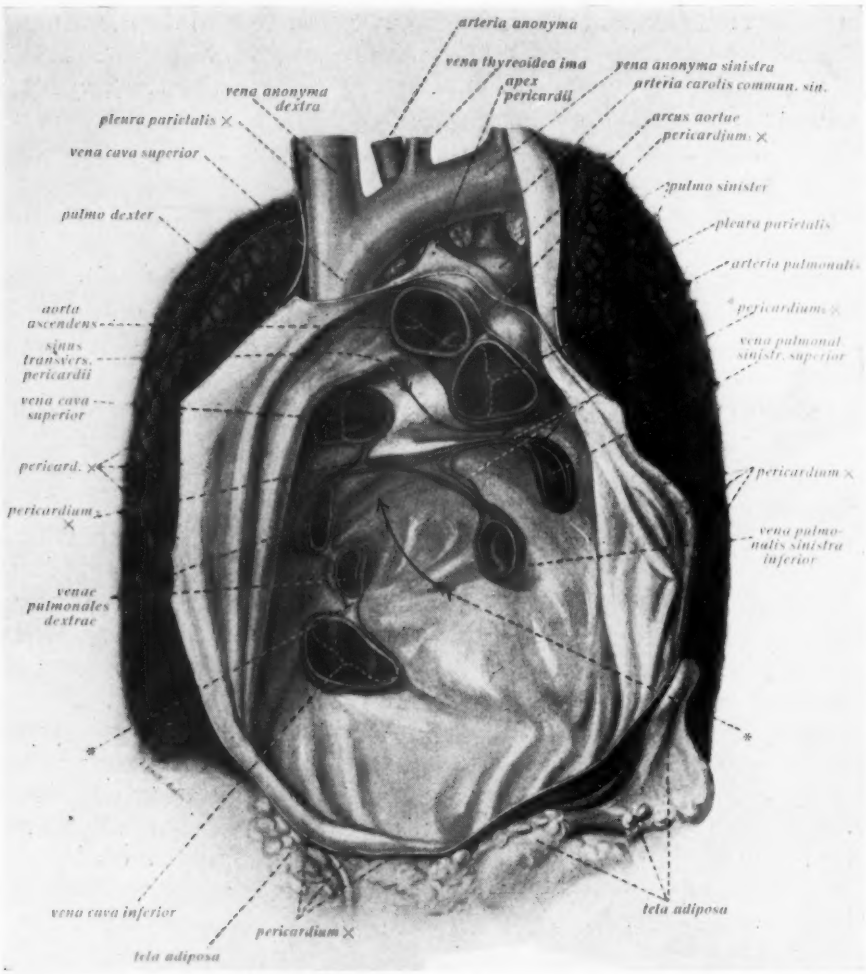

Fig. 24. Anterior view of the pericardium opened from in front, after removal of the heart. The upper arrow is in the transverse sinus of the pericardium. The lower arrow labeled with an * is in the oblique pericardial sinus. (This illustration is Fig. 543 in Vol. II of Atlas of Human Anatomy. By Sobotta and McMurrich.)

cardium. It is argued by Haas that the thinnest and weakest portions of the pericardium occur where the parietal pericardium folds backward into the visceral layer. The fibrous layer separates from the serous layer at those points where only the epicardium merges into the adventitia of some of the great vessels; and thus a sort of pulsion diverticulum is more likely to occur at these locations.[15]

Textbooks of anatomy state that there are but two regions where this reflexion of the parietal into the visceral pericardium takes place, *i.e.*, the transverse sinus of the pericardium, which in the adult will allow the passage of two or three fingers, and the oblique sinus of the pericardium which is sometimes quite deep (Fig. 24). Anatomically, the pedicle shadow which appears to emerge from the hilus could have its origin in either the transverse sinus of the pericardium (with the pedicle appearing in the left hilus) or the oblique pericardial sinus (with the pedicle low in the right hilar shadow under the roentgenoscope or on the roentgenogram).

In the event that a cyst-like shadow inseparable from the heart appears to pulsate during roentgenoscopic examination, careful observation of the pulsations of the opposite free heart border *and* the cyst shadow during roentgenoscopy will show the movements to be synchronous with those of the heart. Roentgen kymography

will demonstrate that the pulsations of the cyst shadow are transmitted and not expansile (Fig. 5).

The essential roentgenologic features of lymphatic cyst of the pericardium and of a true diverticulum of the pericardium may be summarized as follows: a mass adjacent to the heart giving the impression of a flaccid sac containing thin fluid, usually not changing its size over long periods of time, and occasionally pulsating synchronously with the cardiac excursions is generally fortuitously discovered in a patient having no clinical signs or symptoms due to the cyst. It is possible with the slow enlargement of the cyst over a considerable interval of time for the benign cyst to acquire a size which may produce symptoms requiring surgical intervention, as in Case 1 of this report.

Inflammatory pericardial diverticula possess certain special features. They may be accompanied by varying degrees of calcification about the cyst border since these diverticula are associated with chronic exudative pericarditis. Inflammatory diverticula of the pericardium may occur on any border of the heart but all histopathologically proved specimens to date have been found along the right border on the anterior surface. The heart may be either enlarged or normal in size, except for the effusion into the "diverticulum." The encapsulated fluid being thick and serohemorrhagic, these cyst-like formations cast a denser shadow than the simple pericardial cysts enumerated above, and, in addition, they may attain a very large size.[12] Clinical and physical signs do not always lead to the recognition of chronic inflammatory pericarditis and the roentgenological demonstration of an inflammatory pericardial diverticulum may first call attention to the presence of chronic fibrous pericardial inflammation.

Differential Roentgen Diagnosis

Congenital pericardial cysts, true pericardial diverticula and inflammatory pericardial diverticula may be confused with the following: certain benign or malignant tumors of the mediastinum, tumors of the heart and pericardium, echinococcus cyst, cardiac aneurysm, aneurysm of the ascending aorta, saccular aneurysm of the sinuses of Valsalva of the aorta (bulbus aortae)—so-called sinus aneurysm of the heart, aneurysmal dilatation of the left auricle, pericarditis, simple cardiac hypertrophy, anterior mediastinal pleuritis, inferior accessory lobe of the lung, epipericardial fat pad, diaphragmatic hernia, and solitary metastatic nodule in the lung field.

Benign or Malignant Tumors of the Mediastinum. Such new-growths especially if they are round or ovoid, sharply defined, and adjacent to or overlying the heart shadow may have a very similar appearance to the cyst-like shadows inseparable from the heart. However, the major distinguishing feature possessed by the cysts inseparable from the heart-pericardial shadow is the soft, plastic, fluid-containing pouch inseparable from the cardiac silhouette. Kienböck, in first calling attention to the roentgen appearance of inflammatory pericardial diverticulum, spoke of the "Bedeutungslösigkeit des Sackes," *i.e.*, "the insignificance (faintness) of the pouch" shadow or density. The character of this density is shown in the roentgenograms of Cases 1 to v in this report. In the event that the shadow is more dense and opaque, recourse may be had to diagnostic artificial pneumothorax to separate anterior mediastinal tumors and pleurodiaphragmatic cysts from the heart shadow and from the lung.[5,39] Anterior mediastinal dermoid cyst, as well as lymphangiomatous cyst arising in the anterior mediastinum, may in its growth become attached to the anterior surface of the pericardium and roentgenologically the determination of whether it is arising from the pericardium primarily or from the anterior mediastinum outside the pericardium becomes impossible and can only be determined at surgery or autopsy (reference 40 and Case 1 of this report). The absence of clinical symptoms and signs and the harmlessness of all but the largest lymphatic pericardial cysts and of practically all true pericardial diverticula is

helpful in ruling out all the possible malignant mediastinal tumors that might be mistaken for the cystic shadows we are discussing here.

Primary Tumors of the Heart and Pericardium. In general, malignant tumors of the heart and pericardium, whether primary or metastatic, reveal multicentric growth and lead to effusion early. The rapid change in size and shape of the entire cardiac silhouette and demonstration of metastases may be shown roentgenologically. A bronchial or tracheobronchial cyst arising in the pericardium could only be diagnosed histopathologically by examination of the cyst wall. A dermoid or teratoma arising from the pericardium would only be determined if bone or tooth were demonstrated roentgenographically. Teratomatous cysts of the pericardium are reported in young infants and children[13,20,21] and these reports state that roentgenoscopy demonstrates a dense shadow superimposed on the heart and practically covering it. The clinical and roentgenologic impression in 2 cases has been "idiopathic hypertrophy of the heart."[13,20]

Echinococcus Cyst. The simple thin-walled cysts we are discussing do not show heavy calcification in the border, while such heavy calcification in the wall is practically pathognomonic of echinococcus cyst of the heart. Even the calcification in inflammatory pericardial diverticula, when present, never equals that reported in cardiac echinococcosis. In addition, echinococcus cyst of the pericardium is practically unheard of in the absence of older calcified cysts within the heart muscle itself. The older primitive cysts within the myocardium tend to rupture *into* the heart rather than outward into the pericardium.[8] The absence of eosinophilia and a negative echinococcus complement fixation test may help to exclude echinococcus cyst.

Cardiac Aneurysm. These are practically always on the left ventricular border and paradoxical pulsation may be observed at roentgenoscopy or recorded on the roentgen kymogram. Clinical symptomatology would also exclude this condition.

Aneurysm of the Ascending Aorta. Again the faint character of the pericardial cyst shadow and the clinical symptomatology will usually permit the exclusion of aneurysm of the ascending aorta. Inflammatory pericardial diverticula are probably the most difficult to differentiate from such an aneurysm but the normal size of the remaining portions of the aorta, an indentation or slight constriction of the basal part of the inflammatory diverticulum shadow and the clinical symptomatology will rule out aneurysm. Roentgen kymography would be helpful.

Saccular Aneruysm of the Sinuses of Valsalva of the Aorta. Kienböck[23] mistook his first case of inflammatory diverticulum of the pericardium for this condition primarily because of the location of the saccular shadow and the presence of cardiac enlargement and what appeared to be expansile pulsations in the rather dense encapsulated pericardial exudate shadow. The patient was observed over many years and the failure of the shadow to enlarge, the failure of the left ventricle to alter its size appreciably, as well as the stationary character of her symptoms over the seventeen year period that she was studied clinically and roentgenologically, led this author to the diagnosis of chronic fibrous pericarditis with inflammatory pericardial diverticulum. The patient had a definite history of rheumatic fever at the age of fourteen. The clinical symptomatology, the normal size of the rest of the aorta, and the stationary character of the pericardial cyst shadow over a period of time will exclude this type of aneurysm.

Aneurysmal Dilatation of the Left Auricle. At first glance, it might be quite easy to mistake a pericardial cyst for this condition on the posteroanterior chest roentgenogram (Fig. 2, Case 1). The normal left heart border rules out this lesion. In addition, the absence of clinical symptoms and physical signs of mitral stenosis excludes aneurysmal dilatation of the left auricle.

Pericarditis with Effusion. Careful roentgenoscopy of the heart and the clinical

course and symptoms will exclude this condition.

Simple Cardiac Hypertrophy. The pouch-like shape and the density characteristics of the shadows described in this report are not likely to be confused with cardiac hypertrophy if the cyst shadow is located along the upper heart border, but it may be mistaken for a part of an enlarged heart when the cyst is situated low on the heart border and occupies the right cardiophrenic angle (Fig. 16, Case IV). If thorough and painstaking roentgenoscopy of the heart is not done, the cyst might escape detection entirely. The clinical symptoms and signs should help exclude cardiac hypertrophy.

Anterior Mediastinal Pleuritis. The circumscribed and symmetrical outline of the border of the pericardial cyst and its attachment to the heart border *only* or its pedicle attachment into the hilus helps to exclude anterior mediastinal pleuritis. An encapsulated pleural exudate would also be excluded by the entire clinical picture.

Inferior Accessory Lobe of the Lung. The interlobar fissure of this lobe when it is visible, as well as consolidation, atelectasis or bronchiectasis within the lobe, is excluded by virtue of the fact that the lateral border of the lobe is either straight or slightly concave. Roentgenoscopy will settle the question.

Epipericardial Fat Pad. An epipericardial fat pad, especially if located in the right cardiophrenic angle, can present a shadow almost indistinguishable from that of true diverticulum of the pericardium. The differential diagnosis of right median base shadows can be one of the most difficult problems in the interpretation of chest roentgenograms, and the density of a fat pad and the abnormalities emphasized here can appear practically identical on a single posteroanterior chest film. Also the absence of clinical symptoms and signs in the two conditions to be differentiated adds to the difficulty. Meticulous roentgenoscopy with the aid of the filming roentgenoscope as suggested in this report should be an important aid. Thoracotomy can be the final arbiter but if the *art of roentgenoscopy* were concentrated upon the right median base shadows as frequently and as thoroughly as it now is upon the aortic arch and great vessels, the correct interpretation of the confusing shadows in the right cardiophrenic angle would require less operative exploration than is now the case.

Diaphragmatic Hernia. The fact that certain types of diaphragmatic hernia can also be responsible for a confusing shadow in the right or left median base may present a diagnostic problem. Barium examination of the gastrointestinal tract will be of help if the structures it visualizes are in the hernia. An experienced roentgenoscopist would not likely confuse liver density or other opaque contents within the hernia with the pericardial cysts described above.

Solitary Metastatic Nodule in the Lung Field. Meticulous roentgenoscopy of the heart until the pericardial cyst shadow is shown to be attached to the heart-pericardial shadow will exclude the possibility of a metastatic nodule in the lung parenchyma (Fig. 15, Case III, and Yater[51]).

Roentgen Technique

A few remarks concerning roentgen technique in the examination of these cysts may be made.

For the roentgenological demonstration of cyst-like shadows inseparable from the heart no routine procedure surpasses thorough and painstaking roentgenoscopic examination of the chest. Roentgenograms made with a filming roentgenoscope will aid greatly in that roentgenograms can be made with greater ease and accuracy in any unconventional positioning of the patient that may be necessary—most important in demonstrating the cyst borders and margins.

Roentgenoscopy should be done with the patient in the Trendelenburg position to determine if the fluid contents of the cystic shadow can be made to leave the sac—a diagnostic point in favor of a cyst shadow being a true diverticulum of the pericardium.[5] Spot films taken at roentgenoscopy are more conveniently made with the patient in Trendelenburg position than are

Fig. 25. Case v. Anteroposterior laminagram of the cyst shadow made at 11.5 cm. from the posterior surface of the chest. (*1*) Attachment of pericardium to the aorta. This shadow is sharper and more definite on the laminagram than in the reproduction. (*2*) A calcified plaque in the pleura and probably adherent to lateral margin of cystic shadow and producing irregularity of cyst border shown in Figure 23.

films made in the conventional manner.

The value of a lateral decubitus chest film, with the cystic shadow higher than the heart, to show diminution in the size of the mass if the fluid emptied from the sac into the pericardial cavity, is suggested by Mazer in a case report of a true diverticulum of the pericardium safely removed at operation.[33]

Roentgen kymography, as mentioned above, is useful only in producing a permanent record of the transmitted pulsations of the cyst when these are present and to help clarify this point if it has not been settled at roentgenoscopy (Fig. 5, Case 1).

Angiocardiography, by filling the cardiac chambers and great vessels with opaque medium, will demonstrate the intimate contact of the cyst with the heart shadow absolutely, and as the cardiac chambers opacify, the precise anatomical localization of the adjacent pericardial cyst can be accurately determined (Fig. 6 and 7, Case 1).

Laminagrams made at the level of the heart and vascular trunks of the hilar areas may be useful if the cyst is of sufficient density. This procedure should be useful in demonstrating the point of origin of the pedicle shadow in a true pericardial diverticulum possessing such a pedicle. Laminagrams were made of the cyst shadow in Case v. Sections were made at 10, 10.5, 11, 11.5 and 12 cm. from the top of the roentgenographic table with the patient supine upon the table. The laminagram made at 11.5 cm. distance showed the clearest and sharpest outline of the cystic shadow. The film at this level is illustrated in Figure 25. It shows the uppermost attachment of the pericardial fold at its upper anatomical limit—the junction of the ascending aorta with the arch (arrow 1). It was not possible to visualize this fold or attachment on a spot film made at roentgenoscopy in Case v, but the laminagram at 11.5 cm. from the posterior surface of the thorax demonstrated it, and showed this fold to extend outward and to be continuous with the peripheral margin of the cyst shadow. In addition, the laminagram sharply outlined a calcified plaque believed to be in the parietal pleura (arrow 2). In comparing Figure 25 with Figure 23, the pleural calcification is at the exact point of the slight indentation on the periphery of the cyst and is inter-

Fig. 26. Case vi. Posterioanterior chest film showing cyst-like shadow along right heart border.

preted as being fastened to the cyst at this point and distorting the cyst margin. Sections made at the other levels listed above showed no abnormal densities or irregularities within the cyst, indicating that it contains only fluid.

In the detection and study of these cyst shadows the importance of meticulous and thorough roentgenoscopy of the heart cannot be overemphasized.

ADDITIONAL PROVED CASE

After the above material had been assembled and submitted for publication a sixth and very instructive case presented itself.

Case vi, a rather rare malignant mediastinal tumor (removed at operation and studied histo pathologically), is summarized as follows. M. A. D., a forty-two year old corporal in the U. S. Army was admitted to Fort Jay hospital on October 5, 1950, with the signs and symptoms of a common cold. Routine chest film at that time (Fig. 26) showed no evidence of any pulmonary pathology. However, there was distinct widening of the heart shadow in the transverse diameter. Repeat roentgenograms of the chest and roentgenoscopy confirmed this finding and the patient was given a thorough diagnostic study. Physical findings were all within normal limits and all laboratory work was negative. Electrocardiographic studies showed only sinus bradycardia with left axis deviation. On November 17, 1950, the patient was taken to Bellevue Medical Center, New York City, where angiocardiographic studies were done by Dr. George P. Robb. Angiocardiograms in the posteroanterior and anterior oblique positions showed a circumscribed mass lying in the anterior mediastinum near the right lower cardiac border (Fig. 27 and 28). It was thought to be extracardiovascular and, since it caused no deformity of the right auricle and ventricle. probably extrapericardial. The roentgen kymograms taken at that time showed ventricular type motion in phase with the right ventricular motion and apparently due to transmitted pulsations.

The patient was transferred to a general hospital for further examination and study. He entered Murphy Army Hospital on Decem-

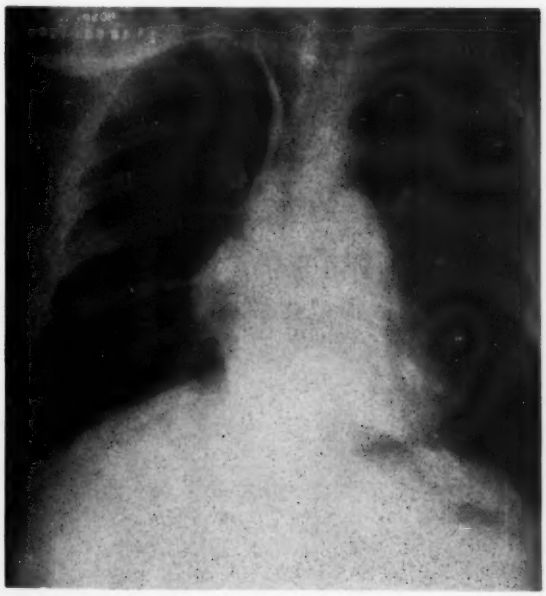

Fig. 27. Case vi. Angiocardiogram showing contrast material in right heart chambers and pulmonary outflow tract in posteroanterior projection. (These angiocardiograms were made by Dr. George P. Robb, Department of Radiology, New York University Hospital, who very kindly loaned the films for reproduction.)

Fig. 28. Case vi. Angiocardiogram showing relation of the cyst-like shadow to the opacified superior vena cava, right pulmonary artery, right auricle and right ventricle. (These angiocardiograms were made by Dr. George P. Robb, Department of Radiology, New York University Hospital, who very kindly loaned the films for reproduction.)

Fig. 29. Case vi. Spot film made at roentgenoscopy (slight left anterior oblique projection) on deep inspiration. Note similarity to Figure 17, Case iv.

Fig. 30. Case vi. Spot film made at roentgenoscopy in right anterior oblique position. Cyst-like density of shadow well shown just above diaphragm and anterior to spine.

ber 28, 1950. At this time he was asymptomatic and showed no signs of any illness. Physical examination was negative and routine laboratory tests were normal. Routine chest film confirmed the findings described previously. Roentgenoscopy supplemented with spot films (Fig. 29 and 30) revealed a mass in the location previously described but apparently blending with the heart-pericardial shadow at the right auricular and right ventricular portions and apparently inseparable from it in all oblique projections. It was the opinion of the radiologist that this was probably a pericardial cyst rather than a pericardial diverticulum because of its relative fixation and lack of emptying on a left lateral decubitus film (with the mass and right border of the heart elevated, Fig. 31).

The patient was presented before the Tumor Board of Murphy Army Hospital and there was some discussion as to whether the chest should be watched and the mass rechecked in a few weeks inasmuch as the patient had no symptoms referable to it and the roentgenological features were reported to be practically identical with those of lymphangiomatous cyst of the pericardium. The Board voted to explore the chest and determine the exact nature of the lesions.

Accordingly on February 16, 1951, the patient was operated upon. The surgeon's operative note is quoted: "An 8-inch curved incision was made over the right 4th interspace, pectoralis muscle divided laterally, cut medially, with interspace entered by sharp dissection. The internal mammary vessel was doubly ligated and cut, the pleura was opened, the cartilage of the 4th rib was incised back to within 1 inch of the sternum. With a spreader in place the chest cage was widened, the lung was allowed to collapse and the tumor was visualized. It measured approximately 6 by 8 by 5 cm. and extended from the anterior portion of the pericardium laterally into the pleural cavity.

Fig. 31. Case vi. Left lateral decubitus film with the mass and right heart border elevated. No significant emptying of cystic shadow rules out pericardial diverticulum.

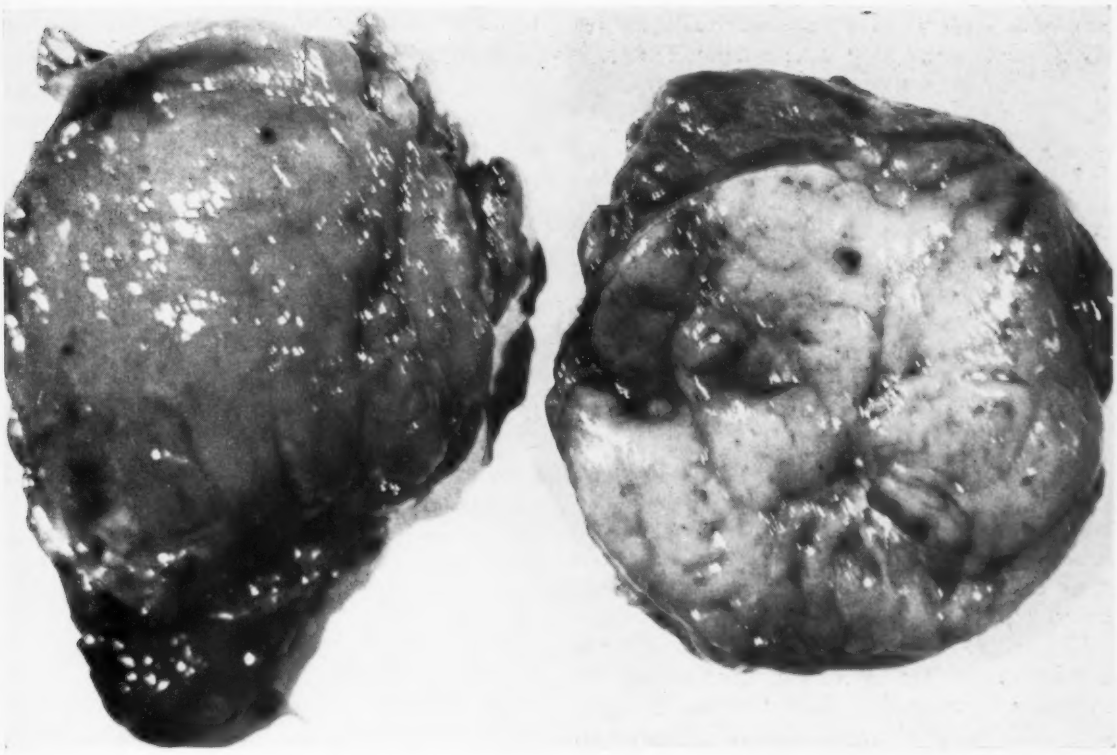

Fig. 32. Case VI. Surgical specimen sectioned through the vertical axis.

It was soft but firm and irregularly lobulated. The overlying mediastinal pleura was incised and the tumor mass was removed by blunt and sharp dissection. The cortical stalk, which was very fine and contained only a few veins, extended upward and anteriorly into the superior mediastinum. A small amount of bleeding was controlled by packing and oxachol was placed in the bed of the tumor mass. The lung was re-expanded, the chest wall was closed in layers with interrupted No. 2 chromic through the cartilage, interrupted ooo silk through the intercostal muscles and pectoralis major and black silk to the skin. Postoperative condition was good."

The surgical specimen (cut in half) is shown in Figure 32.

The report of the pathologist was as follows: "Received a roughly spherical mass measuring 10.5 by 8 by 5 cm.; at one end there was a tail of loose fibrous tissue 0.4 cm. long. The tumor feels fluctuant; one surface is covered with a flat shiny piece of fibrous tissue 4 cm. square. On cut section the capsule is found to be uniformly thin (1–2 mm.). The tumor has a fairly homogeneous light tan medullary appearance. It has the consistency of fresh brain tissue. There are two small (8 mm.) cystic areas surrounded by fresh and old hemorrhages. An interesting feature of the tumor histopathologically is the presence of an occasional, rather poorly differentiated and immature thymic corpuscle. Another feature, less conspicuous, is the presence of a poorly defined pattern of communicating trabeculae, in which the cells are more loosely arranged, tend to spindle out and suggest a type of reticular lymphoid tissue. There are no true lymph follicles and no areas of necrosis. Because the tumor is composed of mature cells resembling lymphocytes, because it has completely replaced the normal thymus and since it is growing with moderate rapidity, I should consider it as a lymphosarcoma, and because it is growing within the thymus and since it retains features of the thymus, I think it should be included in the family of primary thymic tumors." A photomicrograph of the histopathologic specimen is shown in Figure 33.

The patient was given postoperative roentgen therapy as follows: 250 kv. (peak) (Westinghouse constant potential apparatus), 15 ma., half-value layer 2.4 mm. Cu. 50 cm. target skin distance and Thoraeus filter (0.66 mm. Sn plus 0.25 mm. Cu plus 1 mm. Al). Treatment was carried out by cross-firing the anterior mediastinum through two anterior and two

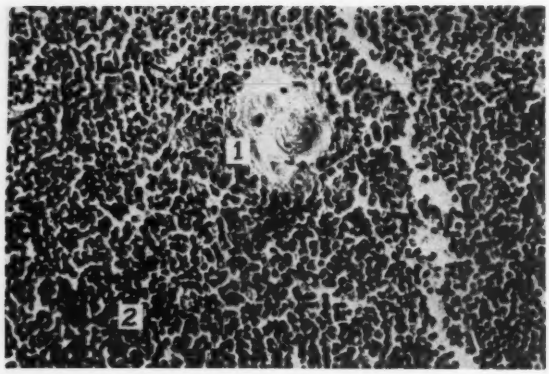

Fig. 33. Case VI. Photomicrograph of section from specimen shown in Figure 32. (*1*) Abortive Hassell corpuscle. (*2*) Sheet of uniform lymphocytes.

posterior portals (10 by 10 cm.). The area previously occupied by the tumor and its stalk received a total of 2,844 r in twenty-four treatment days.

The patient had an uneventful course in the hospital after the operation and during the radiation therapy. His chest film made at the end of his hospital stay is shown in Figure 34.

DISCUSSION

The pericardium can be the site of several specific types of cyst.

Lymphangiomatous cyst of the pericardium, true diverticulum of the pericardium and inflammatory pericardial diverticulum may cast cyst-like shadows inseparable from the heart-pericardial shadow.

Table II summarizes the case reports of such cyst-like shadows which have been studied roentgenologically *and* histopathologically.

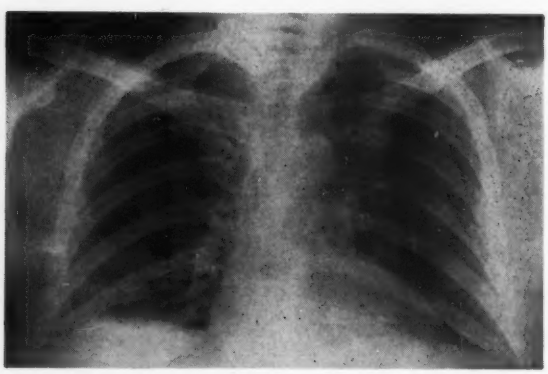

Fig. 34. Case VI. Posteroanterior chest film after surgery and completion of roentgen therapy.

Table II shows: (1) the sex in the 12 proved cases was 7 females and 5 males; (2) the age was not definitely stated in 1 case except to report the patient as being "aged." The average age for the remaining 11 patients is a little over forty years. When only the true diverticula of the pericardium and the pericardial lymphatic cyst cases are considered, the average age of these patients is forty-nine years; (3) clinical symptoms were not present in the 6 cases of true diverticulum of the pericardium; (4) inflammatory diverticulum of the pericardium (encapsulated pericardial exudate) will have the symptoms and signs *and the prognosis* of the underlying chronic inflammatory pericarditis. The youngest case in this group was a fourteen year old boy and the oldest was a forty-eight year old man; (5) in the group of 12 cases the cyst shadow occurred on the right heart border in 11 patients, on the left border in 1 patient; (6) 6 of the 12 cases were true diverticula of the pericardium, 2 of which were successfully removed at operation.

Whereas the thin-walled cysts discussed in this paper are usually quite harmless as regards symptomatology and clinical signs, it is not the same in regard to their roentgenological aspects. They may be easily and readily confused with the most serious lesions and may be mistaken for a wide variety of disease processes. Case VI reported in this paper was a primary thymic tumor (lymphosarcoma) and showed practically all the roentgenological criteria of a primary cyst of the pericardium.

Mass roentgenography of the chest and the high point of perfection attained by modern thoracic surgery will no doubt lengthen the list of proved cases of the benign cysts in the future. The cyst shadows in Cases I and IV of the present report were first detected through a mass chest survey, although the exact nature of the abnormality was, of course, not demonstrable on the photofluorographic film. The case

Table II—Summary of Cases

THIN WALLED PERICARDIAL CYSTS STUDIED ROENTGENOLOGICALLY AND HISTOLOGICALLY

Authors	Sex	Age	Symptoms from Cyst	Roentgen Findings	Surgery	Autopsy	Pathological Findings
(Cystic lymphangioma)							
Yater	M	52	o	A 5 cm round shadow at apex of heart above left diaphragm. No fluoroscopy of heart. Film only.	o	X	Lymphatic cyst (4.5 cm×2.5 cm) arising from parietal pericardium at apex of heart. Also large ulcerating adenocarcinoma of stomach was present.
Loehr	F	50	X	Large ovoid density over ant. rt. auricle & rt. ventricle. Smaller cyst-like shadow projecting from larger density. Transmitted pulsation only. No change with resp. or change in position of patient.	X	o	Lymphangiomatous cyst (13×9×1 cm) arising from parietal pericardium overlying rt. auricle, rt. ventricle & rt. inferior pulmonary vein.
(True diverticulum of the pericardium)							
Seidler	F	63	o	Round mass size of apple on rt. heart border. Synchronous pulsations with rt. ventricle. Enlarged heart. Impression was aneurysm or dilated aorta.	o	X	Diverticulum pericardium size of hen's egg on rt. ventricle, anterior surface. Cardiac hypertrophy. Hydropericardium. Marked atherosclerosis aorta.
Kedrowsky	F	47	o	Cyst-like shadow lower rt. heart border. Heart appeared enlarged to the right.	o	X	Diverticulum of pericardium (5.5 cm×2 cm) on right anterior surface of heart. 3.5 cm opening from divert. into the pericardial cavity.
aderholm	F	52	o	Mitral heart configuration. Round cyst-like shadow size of an apple at lower right heart border. Did not pulsate.	o	X	Thin walled diverticulum of pericardium on ant. rt. ventricle. There was a "pencil size" opening into pericardial cavity. Exact measurement of divert. size not stated. Mitral stenosis.
Schuster	F	Aged	o	Large mass hanging along rt. heart border. Synchronous pulsations. Normal heart size.	o	X	Large diverticulum of pericardium at upper surface rt. auricle. Exact size of divert. not stated. No data on size opening into pericardial cavity.
Mazer	F	55	o	A 6 cm pear-shaped mass in rt. cardiophrenic angle. Mass said to move with diaphragm. Did not pulsate. No change in mass on resp. or change in position of patient.	X	o	"Retort-shaped" sac (8×4×1.5 cm) removed from lower rt. heart border. Fluid in sac could be emptied into pericardial cavity at operation, a communicating opening estimated at 0.5 cm in operative note. *Histology:* Lining of sac composed of well differentiated serosal cells. Divert. of pericardium.
Brown	M	24	o	Rounded mass in rt. cardiophrenic angle. Synchronous pulsations with heart. Heart normal size. The mass disappeared with patient in marked Trendelenburg position.	X	o	A sac (5×3×2 cm) was removed from rt. lateral wall of lower half of pericardium. Operative note reports an 0.5 cm communicating tract into pericardial cavity. *Histology:* Biloculate sac with lining of flat polyhedral cells, hernial sac, pericardial, serosal.
(Encapsulated pericardial exudate-inflammatory pericardial diverticulum)							
Kienböck & Weiss (Case III)	F	37	X	Apple-size, round mass in rt. hilar area. Heart enlarged to left. No change in size of hilar mass 1 yr. & 1½ yrs. later. Cardiac enlargement increased over this time.	o	X	Pericardium adherent over entire heart surface. Round cavity, "size of a fist" on ant. surface rt. auricle. Contained yellow pasty material. Chronic adhesive pericarditis with encapsulated pericardial exudate over rt. auricle.
Freedman	M	14	X	Heart shadow enlarged & globular; effusion into pericardial cavity with encapsulation on rt. About 19½ months later there was normal left heart contour and double-oval protrusion along entire rt. heart border. Mass did not pulsate. It lengthened on insp. & broadened on exp.	X	o	Pericardiotomy performed. Pericardium was 5–6 mm thick. There was 300 cc thick pus in sac along rt. border. *Histology:* Encapsulated pericardial exudate (tuberculous).
Freedman	M	48	X	Left heart border sl. enlarged. An ovoid density overlapping rt. cardiac contour-measured 14 cm long 6 cm wide. Linear areas of calcification, some also on left. Mass did not pulsate. There was 8 cm soft protuberance on external surface between 3–5 rib just to rt. of sternum, pulsated, non-tender.	o	X	Abscess cavity (15 cm in diameter) base of which was formed by epicardium. Contained 350 cc yellowish brown fluid. Adjacent pericardium calcified to thickness of 5 mm. Sinus tract eroded rib cartilage & extended into a 3 cm cavity in rt. pectoral muscle. *Histology:* Encapsulated pericardial exudate (tuberculous).
Reitan (Case II)	M	41	X	Pear-shaped sac with sl. calcification rt. heart border. Synchronous pulsations. Few months later 2nd sac over conus pulmonalis on RAO film. Rt. sided mass enlarged over several months time.	o	X	A cystic encapsulation of 1 liter yellow fluid in rt. pericardial sac. Smaller amt. fluid in sac over conus pulmonalis. *Histology:* "cholesterin pericarditis." Neg. for tuberculosis or neoplasm.

reported by Brown and Thomas[5] was investigated clinically and explored surgically, as the result of an unusual shadow in the right cardiophrenic angle first detected on a routine photofluorographic chest examination.

Roentgenoscopy supplemented with spot films, as demonstrated in most of the illustrations reproduced here, can be of far more value in the diagnosis of this group of pericardial abnormalities than is currently appreciated.

However, the thoracic surgeons have the truth on their side when they say, "The presence of a radiographic shadow such as is produced by these lesions necessitates surgical intervention, for only by visual and pathologic examination can the presence or absence of malignancy be determined."[35a] This quotation is fully confirmed by Case VI reported here.

SUMMARY

A classification of cysts of the pericardium based upon the pathologic anatomy recorded in case reports found in the available literature is offered.

A proved case of lymphangiomatous cyst of the pericardium is reported. The cyst was studied thoroughly by the roentgen method (including angiocardiography) and was successfully removed at operation.

Four cases showing cyst-like shadows inseparable from the heart-pericardial shadow, but not proved histopathologically, are reported. Two of these (Cases II and III) fulfill the roentgenological criteria of lymphatic cyst of the pericardium and two (Cases IV and V) fulfill the criteria of true diverticulum of the pericardium.

The roentgenological aspects, differential diagnosis, and technical procedures helpful in the detection, examination and interpretation of thin-walled cysts inseparable from the heart and pericardium are discussed in detail.

The importance of thorough roentgenoscopy of the heart, supplemented by spot roentgenograms, in the demonstration of these abnormalities is emphasized.

The literature on cysts of the pericardium is reviewed and a list of references is presented.

A proved case of primary thymic tumor (lymphosarcoma), which was roentgenologically indistinguishable from pericardial cyst, is reported.

The author wishes to express his deep gratitude and appreciation to Dr. Raymond C. Beeler, Professor and Head of the Department of Radiology, Indiana University School of Medicine, for the facilities for studying Cases I to V and for the stimulating help and advice of a master teacher.

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THE ROENTGENOLOGICAL ASPECTS OF HEART CATHETERIZATION*

NORMAL AND ABNORMAL POSITIONS OF THE CATHETER WITHIN THE HEART

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IN THE procedure of heart catheterization, when used as an aid in the diagnosis of disease or anomalies of the heart, the correct localization of the catheter by means of the roentgenoscope is of great importance. First, the correct localization provides an anatomical approach to the diagnosis of the heart lesion through the observation of the exact passage and position of the catheter within the heart or great vessels. Thus, the catheter may be observed passing through an interatrial septal defect, through a patent ductus arteriosus, or into an anomalous pulmonary vein. Second, when the true position of the catheter is not appreciated, errors will occur in the interpretation of the data.

For the most part, articles on cardiac catheterization have been confined to physiological studies, to reports on unusual findings, and to discussions of operative technique. Sosman,[3] Dexter,[2] and Cournand *et al.*[1] in this country have published illustrations of the catheter within the heart. In most cases, however, the films were made in the posteroanterior projection. In our series, almost routinely we have obtained lateral as well as posteroanterior views; we wish to emphasize the importance of the lateral view in localizing correctly the position of the catheter within the heart.

From over 300 catheterizations performed at the University of Minnesota Hospitals, we have collected a series of roentgenograms for demonstration and teaching purposes. The illustrations for this paper are from this collection. It should be noted that in ordinary clinical examination roentgenoscopy in the posteroanterior and lateral views is entirely adequate for ascertaining the position of the catheter.

PROTECTION

The roentgenoscopic output at the table top and the scatter to the waist and the hands of the manipulator of the catheter should be measured. Adequate lead shielding should be put in place. At the University of Minnesota a 1.5 millimeter lead shield is placed between the patient's body and the hands of the operator. The arm of the patient is inserted through a hole in the lead shield. The entire team, consisting of an internist, a pediatrician, a radiologist and a technician, wears lead aprons during the roentgenoscopic period. The roentgenoscopic time is limited to ten minutes. This provides adequate time for the catheterization and yet will not allow radiation damage if the patient receives another roentgenoscopic examination during his stay in the hospital. An attached mechanical timer automatically shuts off the roentgenoscope at five, seven, nine, and ten minutes, thus reminding the roentgenoscopist of the roentgen exposure limit. The roentgenoscopic shutters are closed to the smallest dimensions compatible with the localization of the catheter tip.

LOCALIZATION OF THE CATHETER (FIG. 1)

The catheter is threaded up the left antecubital vein to the axilla at which point the roentgenoscope is first used. We do not try to conserve roentgenoscopic time by placing the catheter in the heart unaided

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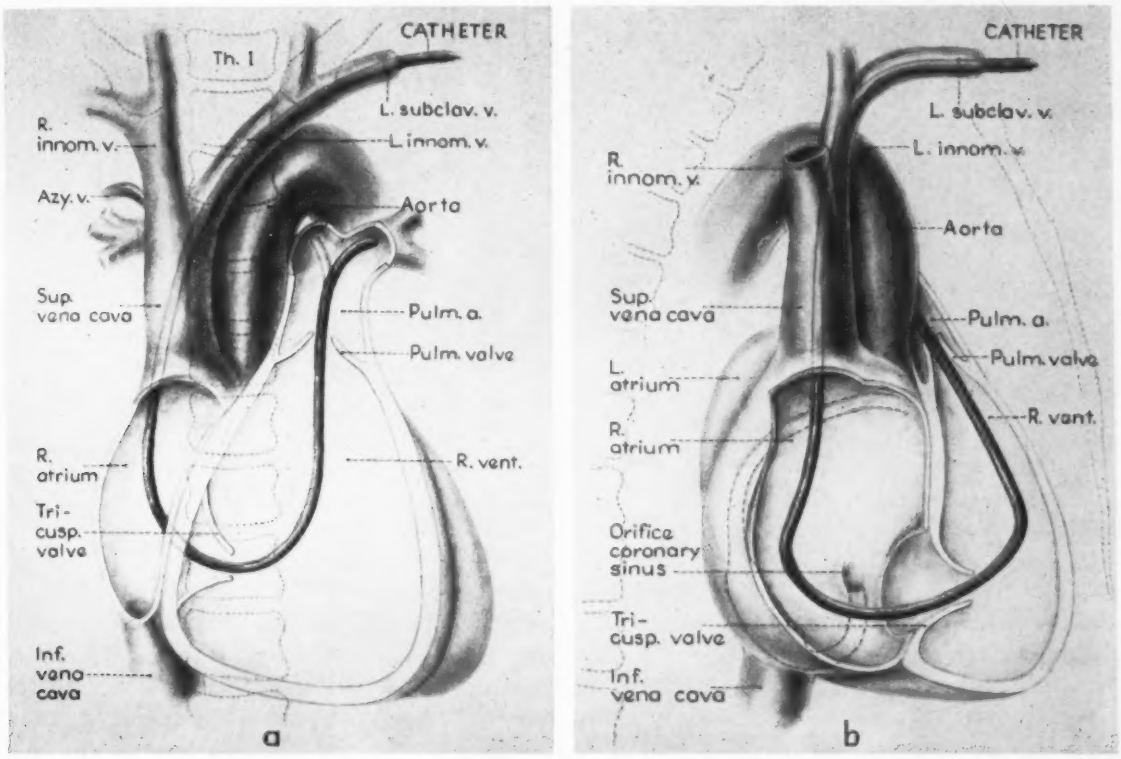

Fig. 1. A diagrammatic sketch of the heart shows the usual path of the catheter through the heart into the pulmonary artery. (*a*) Posteroanterior position. (*b*) Lateral view.

by the roentgenoscope because the cervical veins are too often inadvertently catheterized (Fig. 2). If an obstruction is met at the junction of the left subclavian and the innominate vein, the tip can be maneuvered into the innominate vein by pulling the patient downward on the table so that the left arm extends laterally and upwards. This position improves the thrust angle. Occasionally anomalous pulmonary veins emptying into the superior vena cava may be encountered (Fig. 3). The azygos vein orifice is another frequent obstruction (Fig. 4). It empties into the superior vena cava posteriorly at the level of the fourth thoracic vertebra. The tip of the catheter can be identified within the azygos vein by tipping the patient slightly up on his left side, not disturbing the catheterized arm, and noting the posterior deviation of the catheter tip. Occasionally, a position near the tricuspid valve in the right atrium is difficult to attain because the catheter tends to slip into the inferior vena cava and from there into the left or right hepatic vein. The left hepatic vein may simulate a low position in the right ventricle (Fig. 5). This hepatic deviation may be distin-

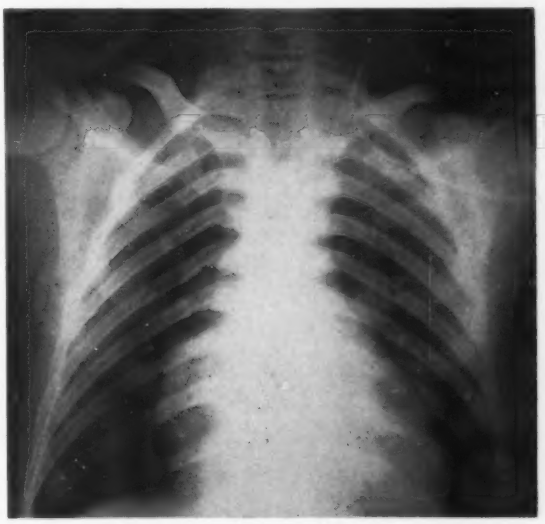

Fig. 2. The catheter tip was advanced into a superficial cervical vein. This should be avoided by using the roentgenoscope.

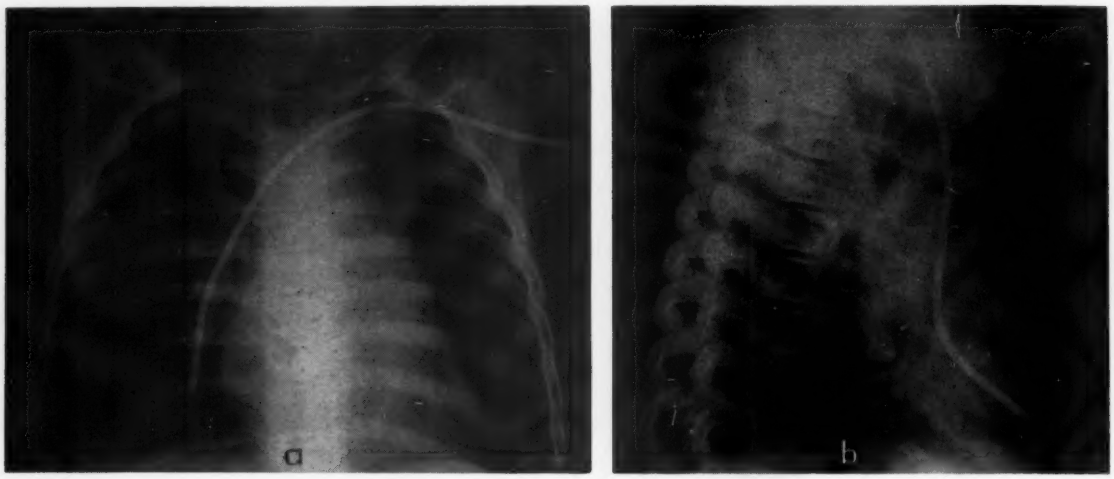

FIG. 3. The catheter tip was threaded into an anomalous pulmonary vein which drains into superior vena cava. (*a*) Posteroanterior view. (*b*) Right lateral.

guished from the right ventricle by having the patient take a deep inspiration and noting that the catheter is below the diaphragm and outside the cardiac shadow. By directing the tip of the catheter medially in the anteroposterior position and anteriorly in a lateral position, the catheter can usually be advanced easily into the right atrium toward the tricuspid valve. The right arm of the patient is mobile so that the patient can at any time be turned into a lateral position on his left side, giving an additional view of the heart. This lateral view is indispensable for the localization of the catheter tip.

After the catheter is in the right atrium, we pass it as quickly as possible into the right ventricle and pulmonary artery be-

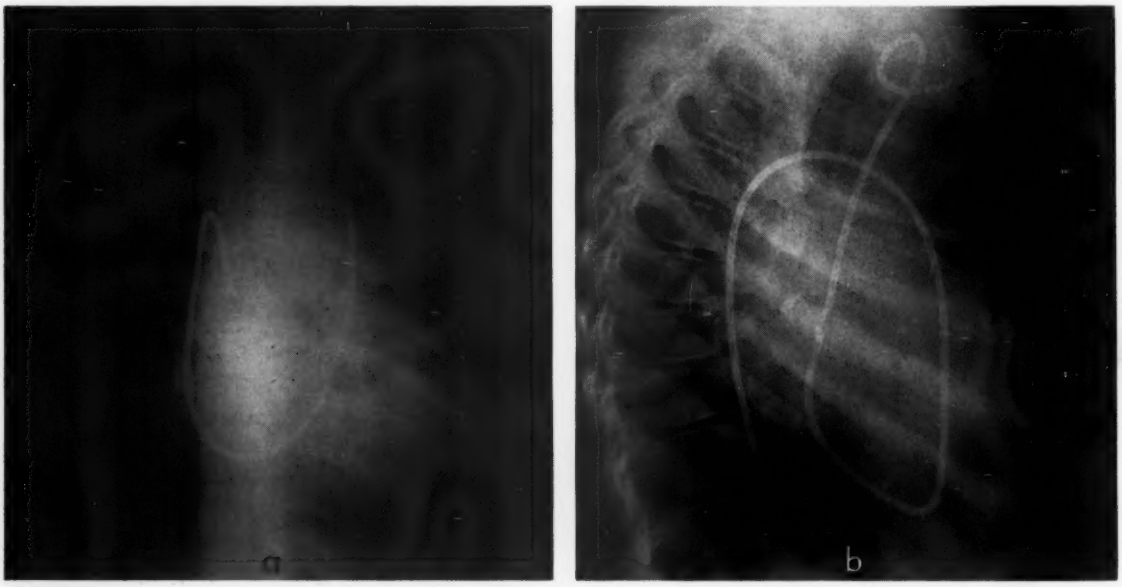

FIG. 4. In this case an anomalous left superior vena cava was present. The catheter was advanced through the left superior vena cava into the right atrium, a partially developed right superior vena cava and thence into the azygos vein. (*a*) Posteroanterior view. (*b*) In the lateral view note the posterior position of the azygos vein along the vertebral bodies resembling the descending aorta.

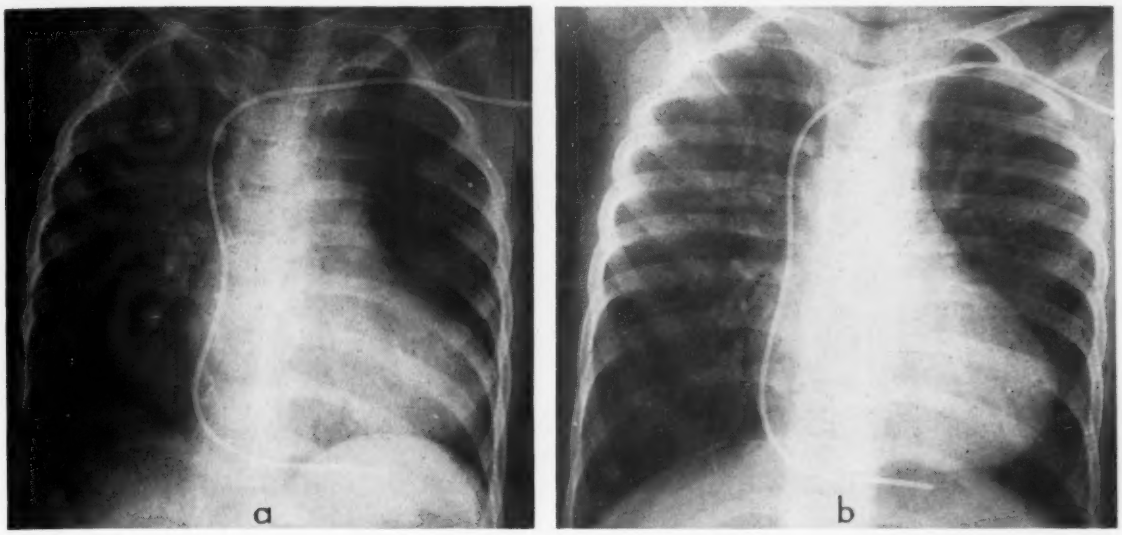

Fig. 5. The catheter tip was threaded into the left hepatic vein. Because of an apparent intracardiac position it was thought to be in the right ventricle. However, on deep inspiration the catheter tip was recognized as being below the heart border. (*a*) Expiration film. (*b*) Inspiration film.

fore the tip loses its temporary baked-in curve. There are three ways of entering the right ventricle. The easiest is to direct the catheter medially and anteriorly and gently thrust it toward the midline. The second method is to loop the catheter in the right atrium and carefully withdraw it until the catheter tip is pointed medially and anteriorly and then thrust forward. Finally, the third method is to pass the catheter loop through the tricuspid valve first followed by the catheter tip. Thus far, we have not had the misfortune of knotting the catheter in the right atrium, but this is a distinct possibility with a flexible catheter.

Several positions of the catheter may mimic the right ventricular position. First,

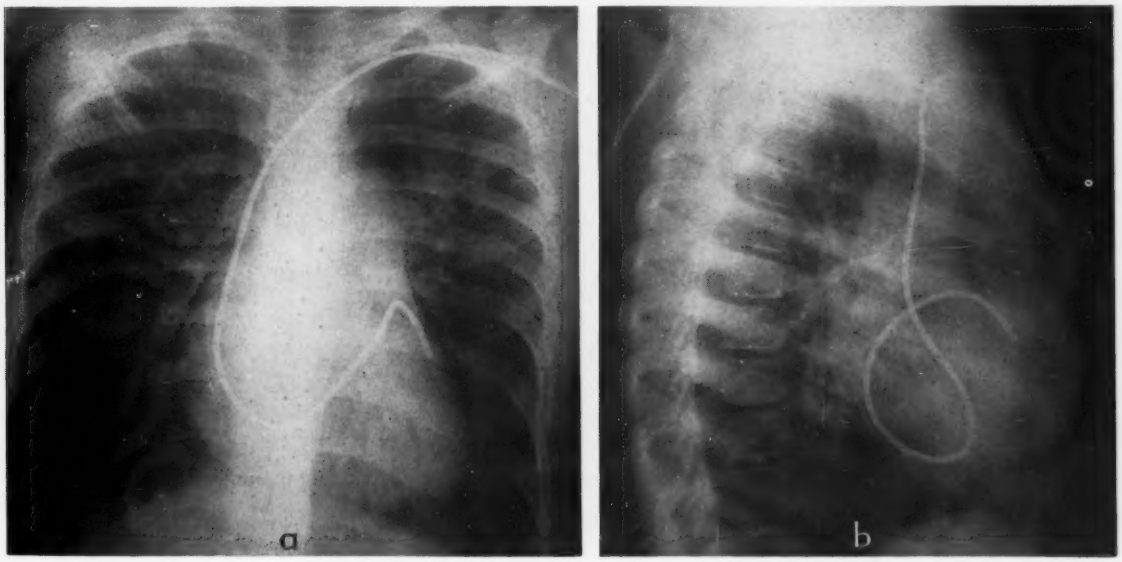

Fig. 6. The catheter tip was advanced through the coronary sinus into the great cardiac vein. (*a*) Posteroanterior view. (*b*) Lateral view.

and most usual, is the coronary sinus which may be easily catheterized unexpectedly (Fig. 6). In such a case the catheter will go directly, usually without obstruction, to the upper left border of the heart where the tip will turn slightly downward and forward and stop. The catheter will appear to thrash as though in the right ventricle due to the large pulsatory movement of the posterior wall of the left ventricle. Often equally misleading will be the pressure recording from the partially obstructed coronary sinus or great cardiac vein showing a high systolic and a low diastolic pressure similar to the tracing seen from the right ventricle. This position in the coronary sinus can be recognized by a constant bend in the catheter in the region of the right atrium which does not change its position as the catheter is withdrawn. By contrast, when the catheter is in the right ventricle the bend in the catheter occurring in the right atrium will tend to swing upward when the catheter is partially withdrawn. Finally, the coronary sinus position can be definitely distinguished from the right ventricular position by the lateral view in which the coronary sinus is posteriorly located while the right ventricle is, of course, anterior.

Second, the catheter in the left atrium or pulmonary vein often mimics entrance into the right ventricle (Fig. 7). Here again, the posterior location of the catheter in the lateral view is diagnostic of either left atrial or coronary sinus position. These can be differentiated by a blood sample. The coronary sinus contains unoxygenated blood, the left atrium, oxygenated blood.

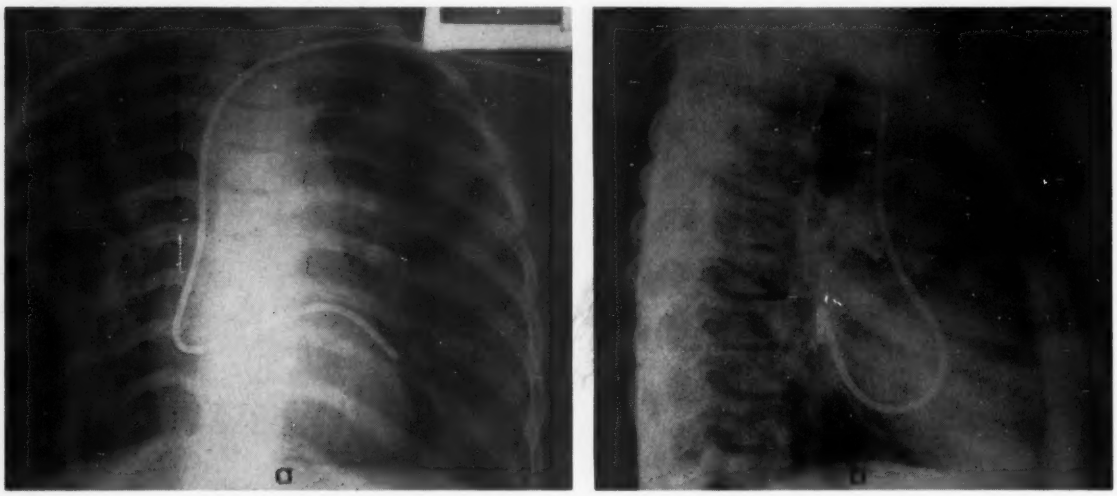

Fig. 7. In a patient with an interatrial septal defect, it is possible to observe the catheter passing from the right atrium through such a defect, into the left atrium and pulmonary vein. The posterior position of the catheter in the lateral view precludes the possibility of the catheter being in the right ventricle. (*a*) Postero-anterior view. (*b*) Lateral view.

Maneuvering the catheter from the right ventricle through the conus into the pulmonary artery may be difficult, especially in a case of tetralogy of Fallot. In such a case the catheter often advances low and anteriorly to the apex of the heart. To allow the catheter to move into this position is futile; it is best to pull back to the tricuspid valve site and repeat the thrust. The tricuspid valve is located variably over the vertebral body, tending to be more to the left in right-sided enlargement of the heart. If the pulmonary artery is not readily entered, the patient is turned into a lateral position to make certain the tip is pointed anteriorly as well as medially. If, after using up five minutes of roent-

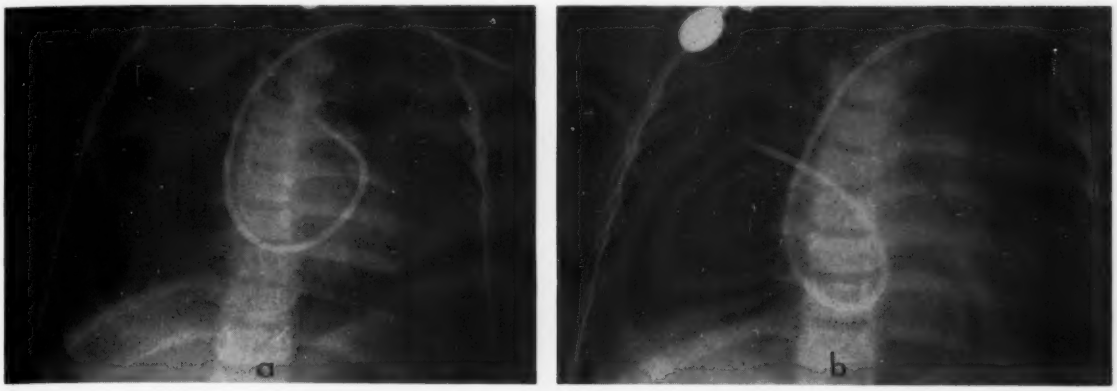

Fig. 8. A case of interatrial septal defect showing the catheter passing both into the right ventricle in normal fashion and into the left atrium through the defect. (*a*) The catheter was passed in the usual normal fashion through the right atrium, right ventricle, and into the pulmonary artery as shown diagrammatically in Figure 1. (*b*) In the same patient the catheter was also advanced from the right atrium through an interatrial septal defect into the left atrium and pulmonary vein. This illustrates the narrow loop which is characteristic of a catheter passing through an interatrial septal defect.

genoscopic time, the pulmonary artery has not been catheterized, another catheter should be substituted in the hope that the new catheter tip will be more suitable for this particular individual.

The pulmonary artery position can be simulated if the catheter enters a pulmonary vein or the aorta (Fig. 8). Again the lateral view is of importance for detecting this unexpected position. Looping of the catheter out into the lung near the right hilus is typical of an interatrial septal defect and should not be confused with the catheter in the pulmonary artery. This pathway may be confused also with an anomalous pulmonary vein draining into the right atrium.

Occasionally, in a case of tetralogy of Fallot or Eisenmenger's complex, the catheter will deviate medially to the right and pass into an overriding aorta (Fig. 9). The catheter may strike against the aortic

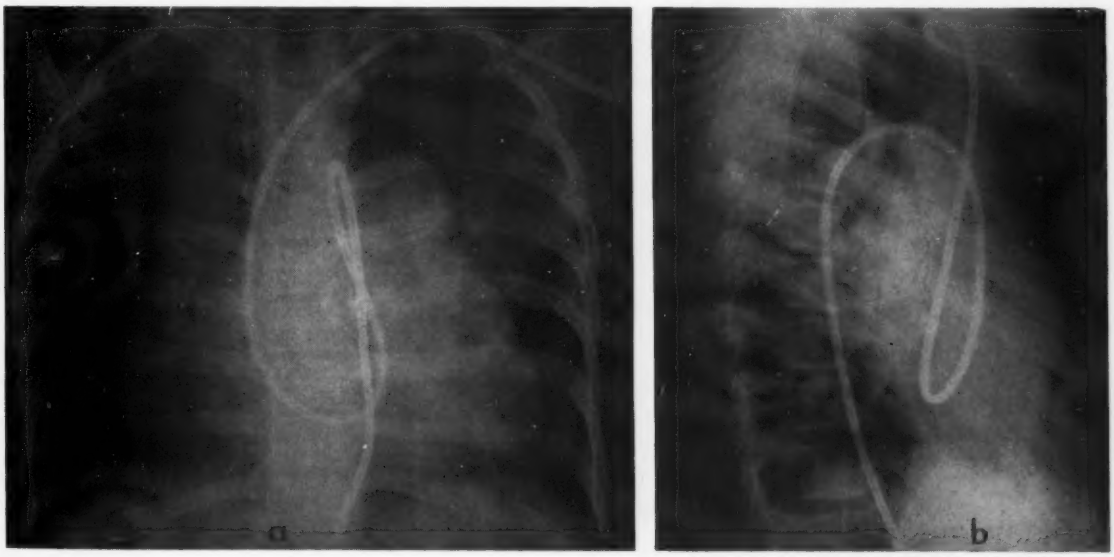

Fig. 9. In a patient with Eisenmenger's complex the catheter was threaded through the right ventricle and extended in a medial direction into an overriding dextroposed aorta and into the descending aorta. (*a*) Posteroanterior view. (*b*) Lateral view.

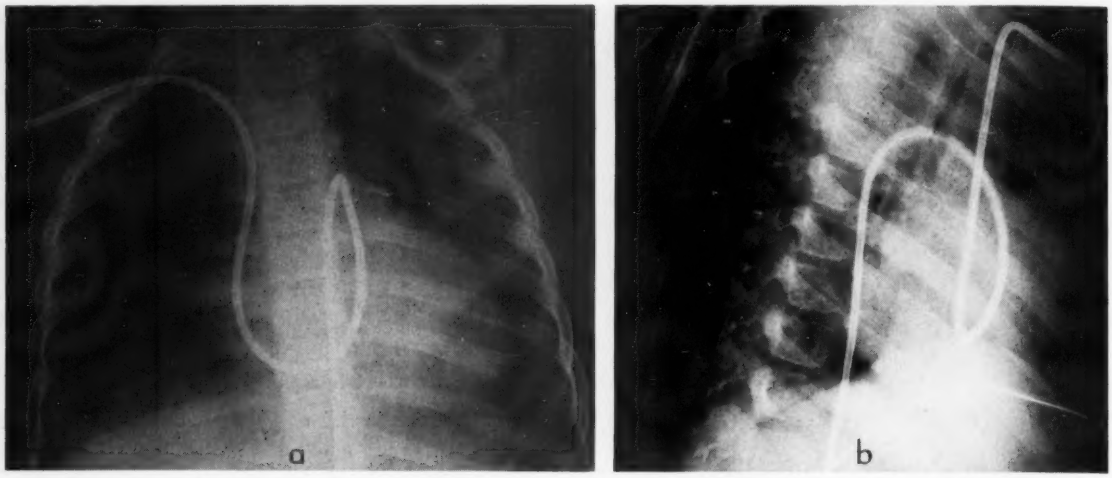

FIG. 10. In a patient with a patent ductus arteriosus the catheter extended in a lateral direction from the right ventricle into the pulmonary artery and thence through a patent ductus arteriosus into the descending aorta. Compare with Figure 9. (*a*) Posteroanterior view. (*b*) Right posterior oblique view.

wall and stop, or it may proceed up into the cervical arteries. This medial position near the base of the heart in the anteroposterior and lateral views should be considered diagnostic of the catheter entering a dextroposed aorta.

The catheter may also be advanced into the aorta via a patent ductus arteriosus (Fig. 10) or it may be threaded through an aortic-pulmonic window (Fig. 11). The aortic-pulmonic window is an opening between the aorta and the pulmonary artery just distal to the pulmonary valve. In a suspected case of patent ductus arteriosus, it is important to try to pass the catheter through the patent ductus because the amount of shunt may be so small that its existence can go unrecognized by routine blood sampling.

In a patient with pulmonary stenosis

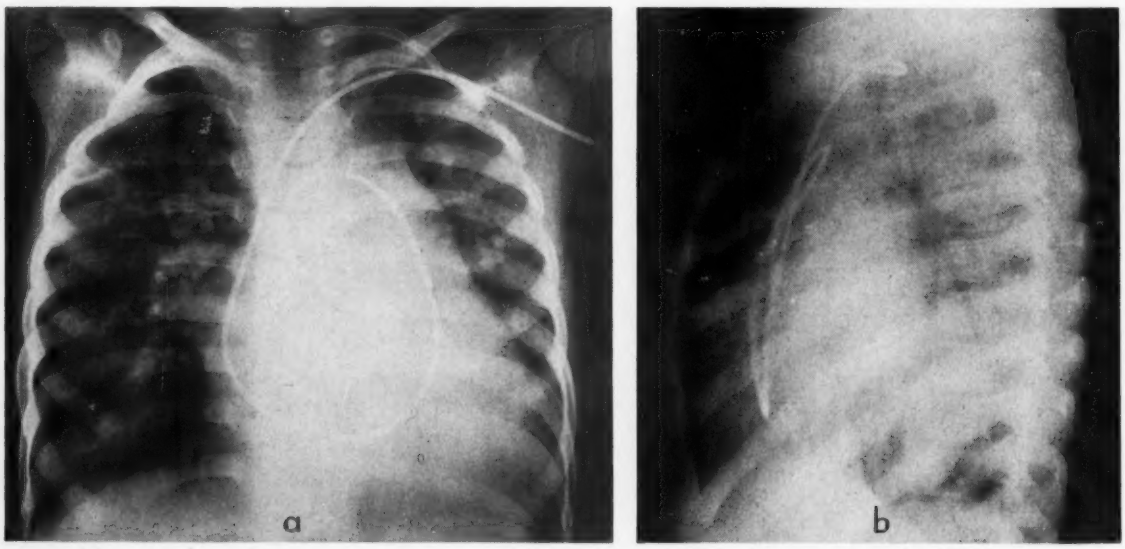

FIG. 11. The catheter was threaded through an aortic-pulmonic window into the ascending aorta. (*a*) Posteroanterior view. (*b*) The lateral view shows the catheter's anterior position in contrast to the posterior position seen when the catheter passes through a patent ductus arteriosus.

the catheter is watched roentgenoscopically as it is being withdrawn from the pulmonary artery while a pressure tracing is recorded simultaneously. By these observations the exact site and the length of the stenosis can be determined and infundibular stenosis usually distinguished from pulmonary valve stenosis.

COMPLICATIONS

Aside from the occasional instances of cardiac arrhythmia and post-catheterization infection, two complications of cardiac catheterization, a spasm of a pulmonary vein and a looping of the catheter upon itself, have been encountered.

The first complication occurred in a patient with an interatrial septal defect. The catheter tip was far out in a pulmonary vein and the operator found that he was unable to withdraw the catheter. Assuming that venous spasm was responsible, he injected novocain into the pulmonary vein and was then able to withdraw the catheter. The patient had no harmful sequelae. Since this experience, we have been careful not to advance the catheter into the smaller pulmonary veins unless absolutely necessary for physiological studies.

The second complication occurred in an eight month old child in whom the catheter was inserted into the right saphenous vein and threaded up the inferior vena cava. A loop formed in the right atrium and when the catheter was partially withdrawn in an attempt to unloop the tip, the catheter slipped into the inferior vena cava below the diaphragm. It could not be advanced again into the heart. The catheter was withdrawn into the more narrow distal portion of the inferior vena cava and became lodged just above the bifurcation. Fortunately, it was possible to maneuver the tip of the catheter into the left iliac vein while the catheter was withdrawn through the right iliac vein. Since this experience any loops formed within the right atrium have been carefully worked out in this chamber and not pulled into the vena cava (Fig. 12).

Fig. 12. The catheter loop was lodged in the inferior vena cava.

THE DETERMINATION OF THE DEFECT BY THE POSITION OF THE CATHETER

We were able to pass the catheter from the pulmonary artery through a patent ductus into the aorta in 7 out of 31 patients who were proved to have a patent ductus arteriosus by subsequent surgery. In 2 of these cases the observation of the catheter passing through the ductus was extremely important as the information obtained through blood sampling during heart catheterization was insufficient to make the diagnosis. Also, the catheter was passed from the right atrium into the left atrium in 21 of 38 patients proved by heart catheterization to have an interatrial septal defect. Passing the catheter into the left atrium through an interatrial septal defect afforded the conclusive proof of the existence of such a defect in 8 of the patients on whom the blood sampling was suggestive but not entirely diagnostic. It must be remembered, however, that a catheter can be passed into the left atrium through a

patent foramen ovale rather than through an interatrial septal defect. To distinguish between these two, it is necessary to consider the entire clinical picture and catheterization findings as well as the position of the catheter.

In cyanotic patients the site of the veno-arterial shunt is diagnostically important and can be established by passing the catheter through the dextroposed aorta or interatrial communication. The presence of a dextroposed aorta was proved by passing the catheter from the right ventricle directly into the aorta in 16 out of 45 cyanotic patients suspected of possessing an aorta overriding the interventricular septum. Often patients with pulmonary stenosis and an interatrial communication are cyanotic. The catheter was passed through an interatrial septal communication in 11 out of 17 patients with a pulmonary stenosis and an interatrial communication. Eight of these 11 patients with veno-arterial shunts through the interatrial septum would have remained undetected by blood sampling alone.

DISCUSSION

Because intracardiac pressures and oxygen saturation values are often so abnormal in congenital heart disease that it is impossible to localize the catheter tip by these means, the competent observation of the position of the catheter within the heart is all-important.

If pressure tracings are taken without the aid of roentgenoscopy, misleading pressures may be recorded when the catheter tip is up against the wall of the chamber, in the great cardiac vein, or occluding a small pulmonary artery branch. Blood samples should not be withdrawn from the pulmonary artery unless the catheter tip is thrashing slightly. This slight movement indicates that the catheter is not obstructing a small pulmonary artery and we can then be certain that the blood sample drawn is pulmonary artery and not pulmonary capillary blood.

A patent ductus arteriosus, interatrial septal defect, or dextroposed aorta may be associated with such a small shunt that the defect is not detectable by blood sampling; thus, the condition may go unrecognized unless the catheter is advanced through the anomaly.

SUMMARY

It is important that the exact position of the catheter tip is recognized at the time when pressures are recorded and blood samples are withdrawn in order to properly interpret the pressure recordings and oxygen saturation values of the blood.

Several cardiac lesions in our series, such as an anomalous pulmonary vein, a patent ductus arteriosus, and an aortic-pulmonic window, were diagnosed solely through our roentgenoscopic observation of an abnormal position of the catheter. Thus, the correct localization of the catheter by means of roentgenoscopy during heart catheterization provides an anatomical approach to the diagnosis of a cardiac lesion supplementing the diagnostic information obtained from routine pressure recordings and oxygen saturation values.

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VOL. 68, NO. 4

THE ROENTGENOGRAPHIC DIFFERENTIATION OF PERIPHERAL ARTERIOSCLEROSIS*

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THE purpose of this paper is to bring again to mind the fact that peripheral arterial calcifications can usually be divided on the basis of roentgenographic appearance into two types, medial and intimal, so that the type of peripheral arteriosclerosis producing the calcification can be diagnosed from the plain film.

Virchow in 1856 distinguished between intimal arteriosclerosis and medial "petrification," and in 1903 Mönckeberg suggested that these two processes had a different pathogenesis and possibly a different etiology.[1,2] Today the different pathogenesis of these two types of arteriosclerosis is recognized, but knowledge of their etiology remains incomplete in spite of much experimental work on the subject.[3,4,5]

The clinical significance of the type of arteriosclerosis that is present may be considerable because of the great difference in the effects of the two types on the peripheral circulation.[6,7] Medial sclerosis does not encroach on the vessel lumen. If any change in the lumen of arteries exhibiting isolated medial sclerosis is present it will be a slight dilatation associated with increased rigidity of the vessel wall. Usually no change in the size of the lumen is apparent. Therefore, if medial sclerosis only is present there will be no impairment of the peripheral circulation.[8,9,10]

Intimal sclerosis, on the other hand, is characterized by the presence of atheromatous plaques which may produce all grades of peripheral vascular (arterial) obstruction and initiate thrombosis with complete occlusion and subsequent gangrene.[6] The associated clinical symptoms of coldness and pallor of an extremity, absent or diminished popliteal or dorsal pedis pulsations, claudication, and gangrene are a marked contrast to the completely asymptomatic presence of isolated medial arteriosclerosis in other patients.

Calcification within the peripheral arteries can usually be differentiated, on the basis of the roentgenographic appearance, into calcification due to intimal arteriosclerosis and calcification due to medial arteriosclerosis. This calcification will be present in all cases of medial (Mönckeberg's) sclerosis by definition. At this point it should be remembered that the two processes are different in pathogenesis. Medial sclerosis is defined as the deposition

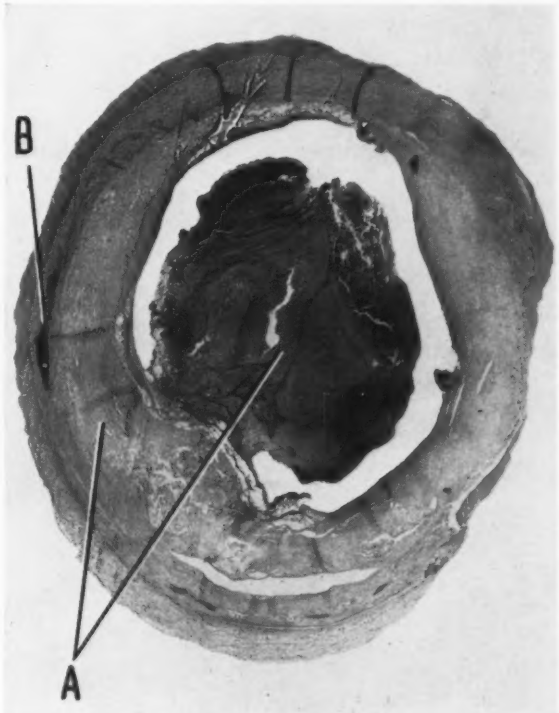

FIG. 1. Photomicrograph of specimen showing marked atherosclerosis and attached thrombus, *A*. No calcification is present in the atheroma. A small amount of calcification is present in the media, *B*.

* Supported in part by a grant from funds of the Charles J. Wolf Foundation for Medical Research, Indianapolis General Hospital.

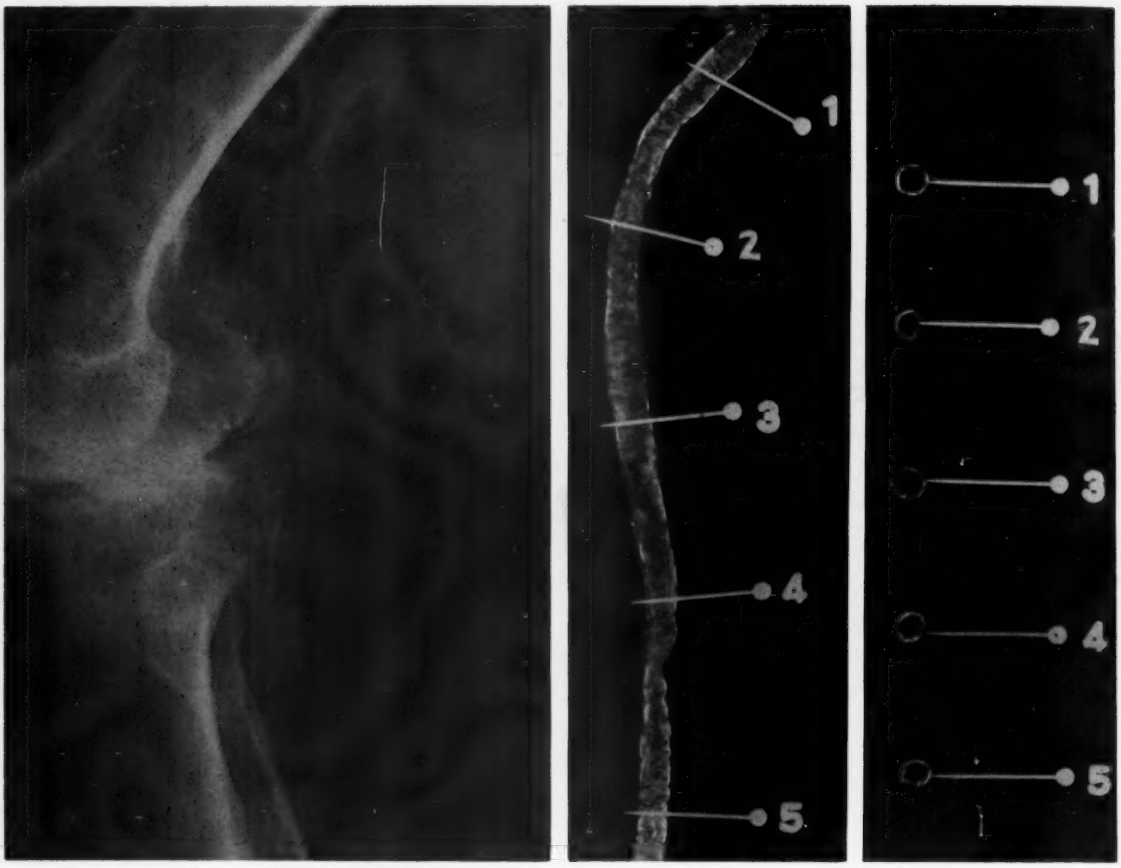

Fig. 2. Medial (Mönckeberg's) arteriosclerosis. The clinical roentgenogram and roentgenograms of the isolated artery in longitudinal and sectional views are shown. The diffuse trachea-like density that is diagnostic of medial arteriosclerosis can be seen in the clinical film. In the roentgenograms of the isolated artery the incomplete ring of calcium within the artery wall and preservation of a normal lumen are demonstrated.

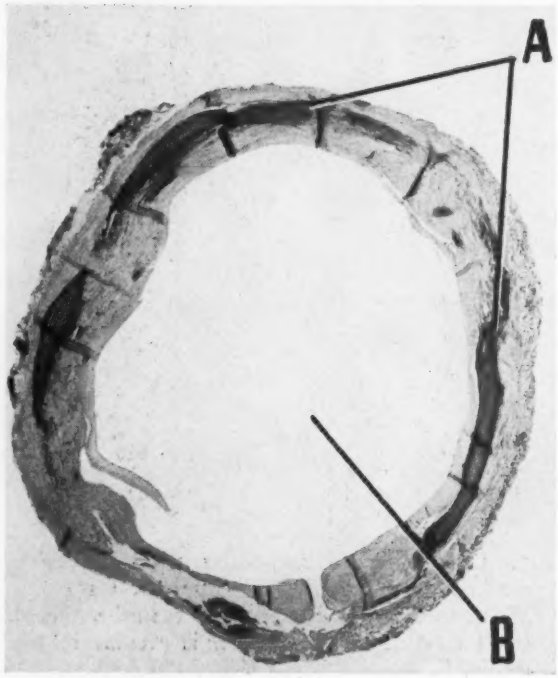

Fig. 3. Photomicrograph of specimen in Figure 2. *A*, calcification in medial coat. *B*, normal lumen.

of calcium within the medial coat of peripheral muscular arteries, while atherosclerosis is the formation of soft, lipoid-containing atheromata in the thickened intima of arteries. Calcification may or may not take place within these atheromata. When atherosclerosis is present in a clinically significant degree only 31 per cent of female patients and 67 per cent of male patients will exhibit calcium within the plaques.[6]

Many patients, especially in the older age group, will have both medial and inti-

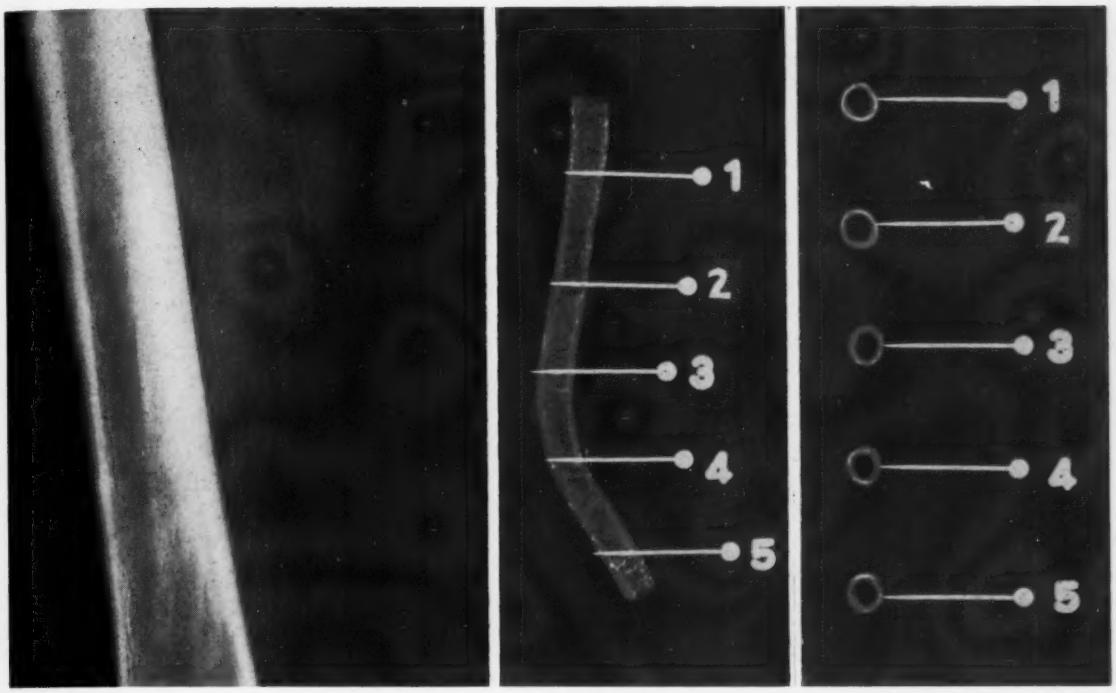

Fig. 4. Medial arteriosclerosis (minimal). The fine hair-like rings of medial calcification are barely visible. A normal arterial lumen is present.

mal arteriosclerosis of their peripheral vessels.[8] In some of these cases it is possible to see roentgenographic evidence of medial sclerosis only, and to find the typical signs and symptoms of peripheral arterial occlusion in the same patient. This is possible because in a definite percentage of patients (as stated above from Allen, Barker and Hines) having clinically evident intimal sclerosis, the atheromatous plaques do not calcify even though the condition is advanced, and therefore only the co-existing medial sclerosis is visualized on roentgenographic examination (Fig. 1).

Medial arteriosclerosis of Mönckeberg begins with the deposit of lime salt granules within the connective tissue of the medial coat of the peripheral muscular arteries,

Fig. 5. Photomicrograph of specimen in Figure 4. *A*, calcification in medial coat. *B*, normal lumen.

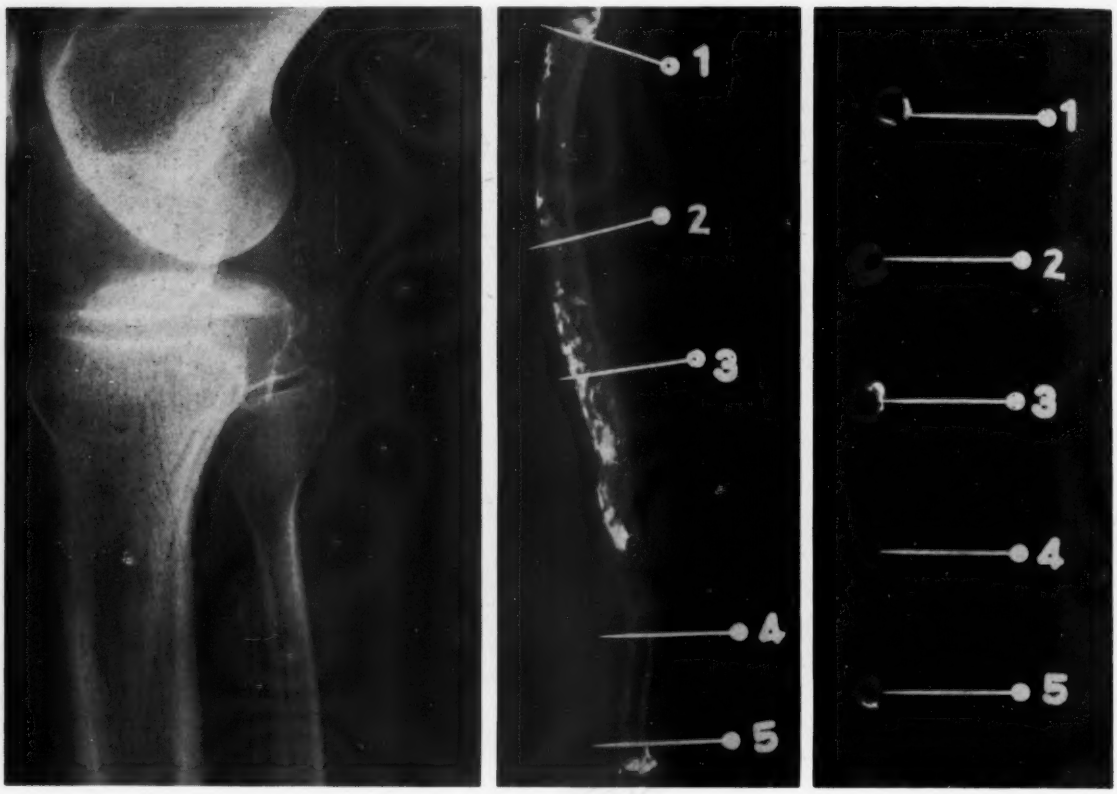

Fig. 6. Intimal arteriosclerosis (atherosclerosis). The isolated plaque-like densities along the course of the artery are typical of calcification within atheromata. The entirely different configuration and manner of distribution of these calcific densities as compared with medial arteriosclerosis is evident. Marked narrowing of the artery lumen caused by intimal proliferation and atheromatous plaques can be seen.

Fig. 7. Photomicrograph of specimen in Figure 6. *A*, atheroma. *B*, plaques of calcium within atheroma.

especially the femorals, popliteals, tibials and radials. Fibrosis and hyalinization follow. As the process advances, the granules increase in number and coalesce to form multiple concentric but incomplete rings or sheets of calcific density within the media producing a trachea or goose-neck appearance on roentgenographic examination.[10,11] The process tends to be diffuse within the involved vessel and often occurs in smaller branch arteries as well. The appearance on the roentgenogram is diagnostic (Fig. 2, 3, 4 and 5).

Intimal arteriosclerosis (atherosclerosis) begins as an accumulation of lipoid-containing macrophages in the deeper aspect

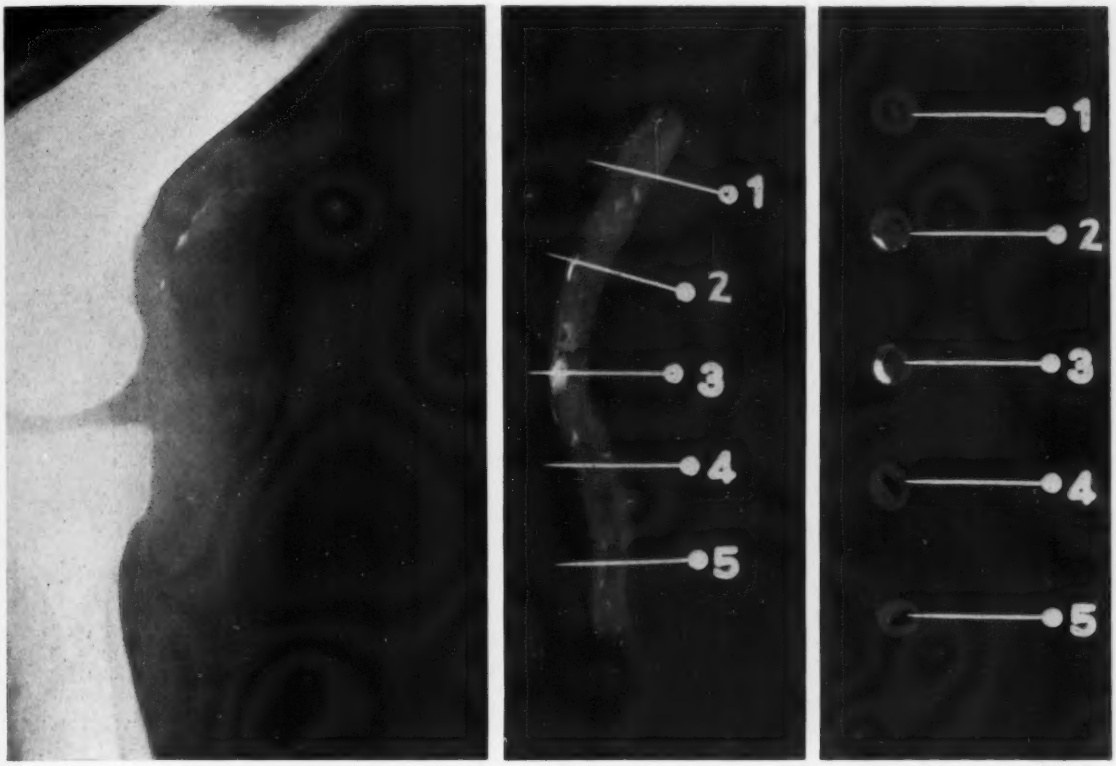

Fig. 8. Intimal arteriosclerosis (atherosclerosis). The same features demonstrated in Figure 6 are present. Calcified plaques are minimal in number

of the intima and is associated with a concurrent intimal and connective tissue proliferation. The accumulation of lipoid material forms atheromata surrounded by fibrous tissue which hyalinizes and later calcifies. The calcification is usually present near the base of the atheromatous plaque and deep in the intima where the process began.[10,11] This calcification has a patchy, plaque-like appearance and may be very dense. The plaques may vary in size from small rounded flecks of calcification to large irregular calcific densities 2 cm. in size and are distributed inconstantly along the course of the artery (Fig. 6, 7, 8 and 9).

When both intimal and medial arteriosclerosis are present in the same artery, a

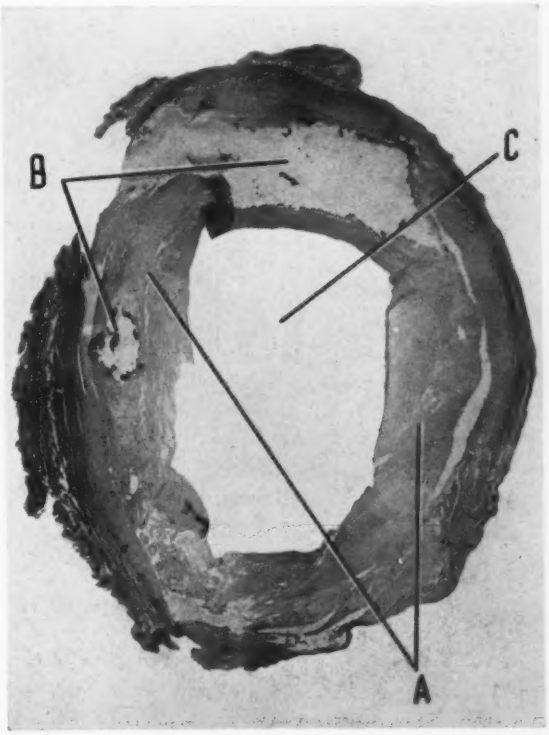

Fig. 9. Photomicrograph of specimen in Figure 8. *A*, atheromata. *B*, calcific plaques within atheromata. Much of the calcium slipped out when the section was cut. *C*, narrowed lumen.

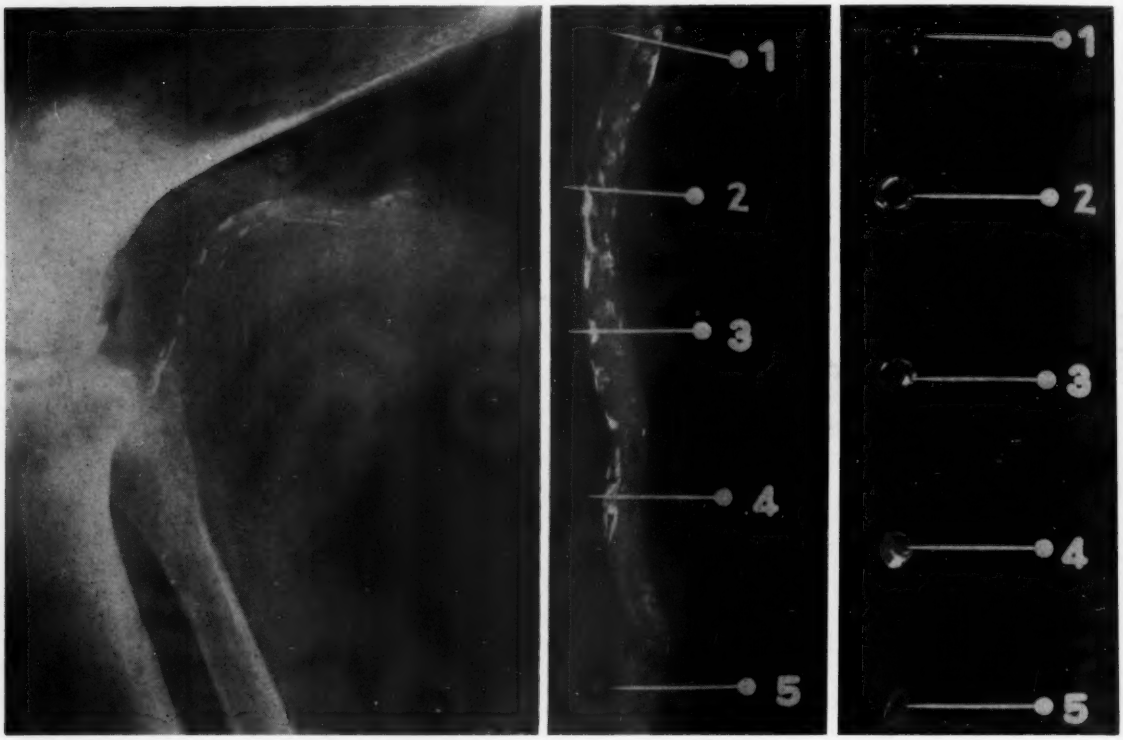

Fig. 10. Both intimal and medial arteriosclerosis. The plaque-like calcific densities and narrowed lumen of atherosclerosis are the outstanding features. Incomplete rings of medial calcification are present in the region of No. 5. In the original film much diffuse medial calcification is also apparent in the tibial arteries (projected between the tibia and fibula).

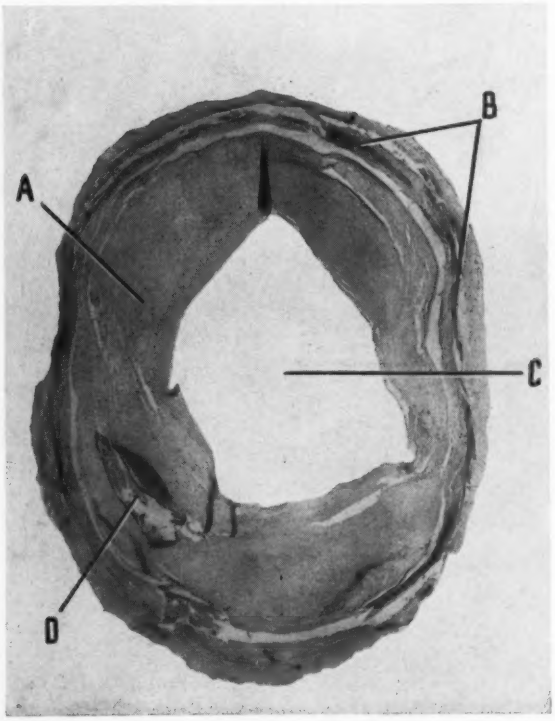

Fig. 11. Photomicrograph of specimen in Figure 10. *A*, atheroma. *B*, calcification in media. *C*, narrowed lumen. *D*, calcific plaque in atheroma.

background of diffuse trachea-like medial calcification of lesser density can sometimes be detected superimposed upon the irregular, isolated, plaque-like densities of intimal calcification, but often the medial calcification is effectively obscured by the more dense plaques of calcium in atheromata (Fig. 10, 11, 12 and 13).

CONCLUSIONS

1. Each of the two types of peripheral arteriosclerosis, medial (Mönckeberg's) and intimal (atherosclerosis) causes calcification of different characteristic appearance in peripheral arteries, and the type of this calcification (and therefore the type of

Fig. 12. Both intimal and medial arteriosclerosis. The features of the small amount of medial calcification in this specimen are nearly obscured by the obvious calcified plaques in atheromata. Diffuse medial calcification in smaller branch arteries is apparent in the original film.

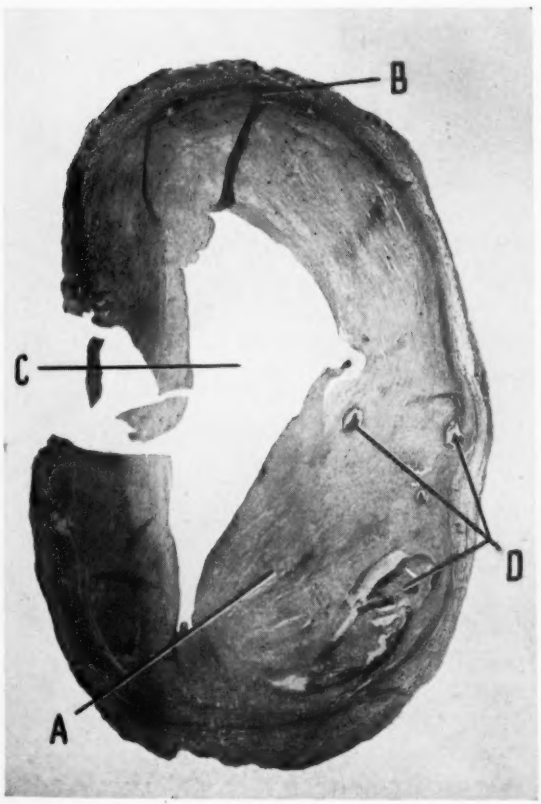

Fig. 13. Photomicrograph of specimen in Figure 12. *A*, atheroma. *B*, calcification in media. *C*, narrowed lumen. *D*, calcific plaques in atheroma.

arteriosclerosis present in the artery) can be diagnosed from the roentgenogram.

2. Both types of arteriosclerosis and both types of calcification may exist in the same artery. In such cases, the more dense calcific plaques of atherosclerosis may obscure minimal medial calcification.

3. Thirty-three per cent of males and 69 per cent of females with clinically evident peripheral atherosclerosis will not have calcium in the atheromatous lesions. When both types of peripheral arteriosclerosis are present in these patients, only the medial calcification will be evident on the roentgenograms.

4. When the roentgenograms reveal dif-

fuse medial calcification in the arteries of patients with no symptoms of peripheral vascular obstruction, the presence of the calcium is of no clinical significance.

5. Roentgen evidence of dense plaques of atheromatous calcification scattered along the course of a peripheral artery indicates narrowing of the artery by atherosclerosis, but medial calcification if also present is of no added significance.

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Vol. 68, No. 4

PULMONARY EMBOLISM*†

EXPERIMENTAL ANGIOCARDIOGRAPHIC STUDY

By ROGER P. LOCHHEAD, M.D., DOUGLAS J. ROBERTS, JR., M.D., *and* CHARLES T. DOTTER, M.D.

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EXTENSIVE experimental investigations into the pathological physiology of pulmonary embolism have resulted in the emergence of conflicting hypotheses. It is generally agreed that sudden incomplete obstruction of the pulmonary arteries may result in right ventricular hypertension.[1,3,4,8] If the increased resistance presented to it is sufficiently severe, the right ventricle fails, with subsequent diminution of the cardiac output and a fall in systemic blood pressure.[1] Although at pneumonectomy clamps may be applied to a main branch of the pulmonary artery with safety, embolic occlusion of a smaller pulmonary segmental artery may result in death.

The etiology of the pulmonary arterial hypertension following nonmassive pulmonary embolism remains unexplained. Does this hypertension represent the direct effect of mechanical blockage of a portion of the vascular tree, or is it an expression of a reflexly mediated pulmonary vasoconstriction? Many of the reported investigations into this problem have involved obstruction of the pulmonary arteries by balloons or clamps, or else by emboli unlike those causing clinical pulmonary embolism.

The present study was designed to explore during life the gross anatomical changes occurring in the right heart and pulmonary arteries following experimental pulmonary embolism similar to that occurring in man. Angiocardiography[9] offers a method for the demonstration of the site and degree of vascular occlusion and for the study of the anatomy of the pulmonary arteries during and following embolization. Similar techniques have been previously employed in this connection,[6,7] but measurement of pulmonary arterial caliber at serial intervals following embolization has hitherto not been reported.

METHOD

Adult healthy dogs weighing 11 to 15 kg. were anesthetized with intravenous pentothal sodium, 28.6 mg/kg. body weight. Angiocardiographic examinations were conducted prior to and at serial intervals following release of a thrombus from the jugular vein.

The embolus was formed by a modification of the technic described by Holden and coworkers.[5] A jugular vein was exposed from the angle of the jaw to the clavicle, the exposed tributaries ligated and clamps placed across the proximal and distal ends of the vessel, leaving the intervening segment distended with blood. Four-tenths cubic centimeter of thrombin solution was injected through a small hypodermic needle into the isolated blood-filled segment of vein. Gentle massage promoted mixing of blood and thrombin with the result that within a few minutes a firm clot became palpable within the vein. If desired, the clot could be labeled by the injection of a few drops of iodochloral into its substance. The clot was released by removing the clamps across the jugular vein. Distal venous pressure usually sufficed to initiate clot movement, although manual "milking" was occasionally resorted to. About two seconds following dislodgement of the clot, the sudden onset of hyperpnea indicated that embolization had occurred.

Angiocardiography was done seven times during each experiment, before, and at one-half, one, two, three, four and five minutes following the release of the embolus. Films were made in the left anterior oblique projection following the rapid injection of 8 to 12 cc. of neo-iopax (75 per cent) into a brachial or jugular vein. Each angiocardiogram consisted of several exposures made at a rate of two per second during

* From the Department of Radiology of The New York Hospital-Cornell Medical Center.

† This investigation was aided by grants from the New York Heart Association and the Schering Corporation.

the period of pulmonary arterial opacification. A Fairchild roentgen-ray roll-film magazine was employed.[2] Target-film distance was 48 inches during all experiments.

Control studies were done on all dogs at a date prior to the day of embolization and consisted of repeated angiocardiographic injections performed under similar conditions but without creation or release of the embolus. In this manner, it was possible to assess the magnitude of pulmonary vascular changes resulting from the repeated angiocardiographic injections alone and to evaluate better the changes seen after embolization.

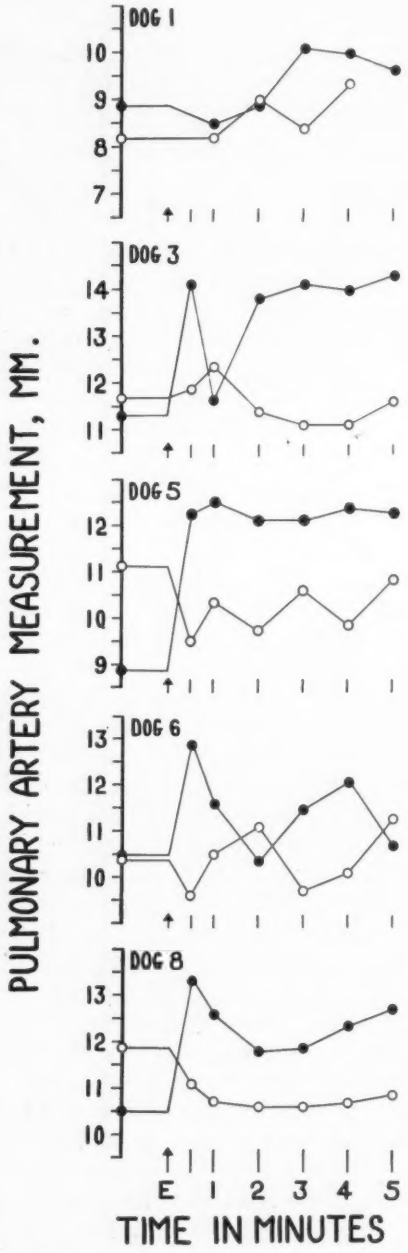

FIG. 1. Graphic representation of average pulmonary arterial caliber in control studies (open circles) and following experimental pulmonary embolization in five complete experiments. Dilatation is definite in Dogs 3, 5 and 8, slight in Dog 6 and not apparent in Dog 1.

RESULTS

Six experiments were done. One of the six animals, Dog 4, died within one minute of the time of embolization. Another, Dog 5, died a few minutes following the termination of the experiment, apparently as the result of the embolus. Dogs 1 and 3 were clinically well a week after embolization. Dogs 6 and 8 showed no evidence of cardiac or respiratory distress when they were sacrificed during the hour following embolization. Thus, in five dogs, complete angiocardiographic observations (including the previously conducted control studies) were available for analysis. The films were examined as to the general appearance of the right heart and the pulmonary arteries. Following every angiocardiographic injection there were available at least three films showing opacification of the pulmonary vessels. From these films, the average caliber at each of four anatomical points (see Fig. 2*B*) was derived and these figures were in turn averaged. The resultant figure expressed the caliber of the central pulmonary arteries at a given time as derived from twelve individual measurements. In this manner systolic-diastolic variation and the effect of respiration on pulmonary arterial caliber were minimized. The data obtained are shown graphically in Figure 1.

The location of the clot was identified in three dogs, 5, 6 and 8, with certainty, and with reasonable assurance in Dogs 1 and 3. In one animal, Dog 6, there was complete occlusion of the left descending pulmonary artery below the origin of the lingular artery (Fig. 2*B*). In Dog 8, the clot could be identified as a filling defect in the descending branch of the right pulmonary artery, entering and partially obstructing all

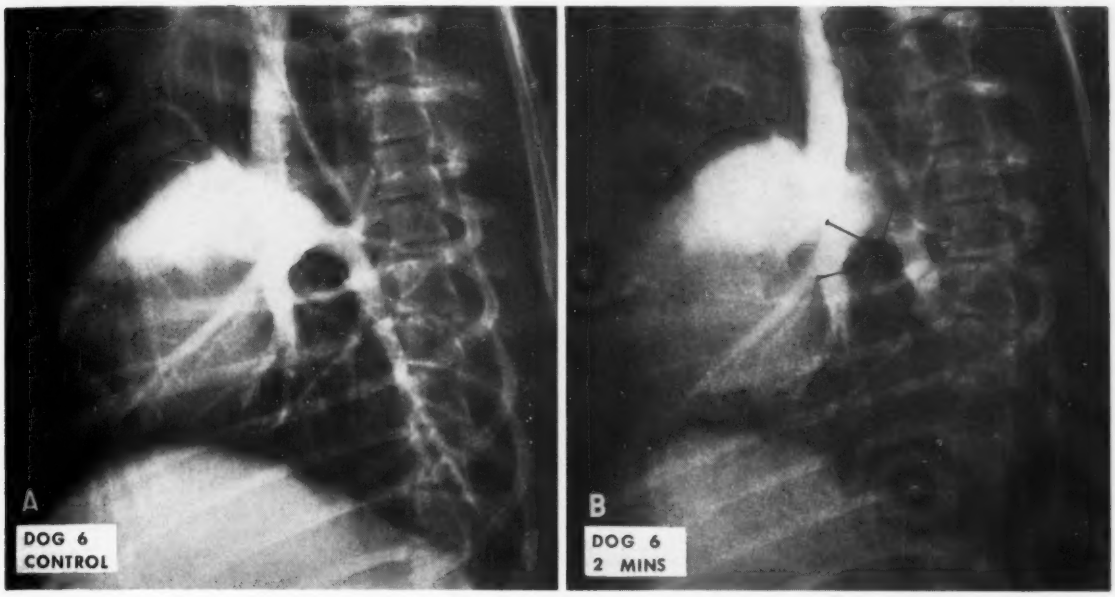

Fig. 2. *Segmental pulmonary arterial occlusion by experimental embolus (Dog 6).* (*A*) Control angiocardiogram shows filling of all segmental branches. (*B*) Two minutes following release of embolus there is occlusion of the basilar branches of the left pulmonary artery, a finding which did not change during the five-minute period of observation. Black lines on (*B*) indicate four sites of pulmonary artery measurement employed in arriving at estimation of pulmonary arterial caliber (see text).

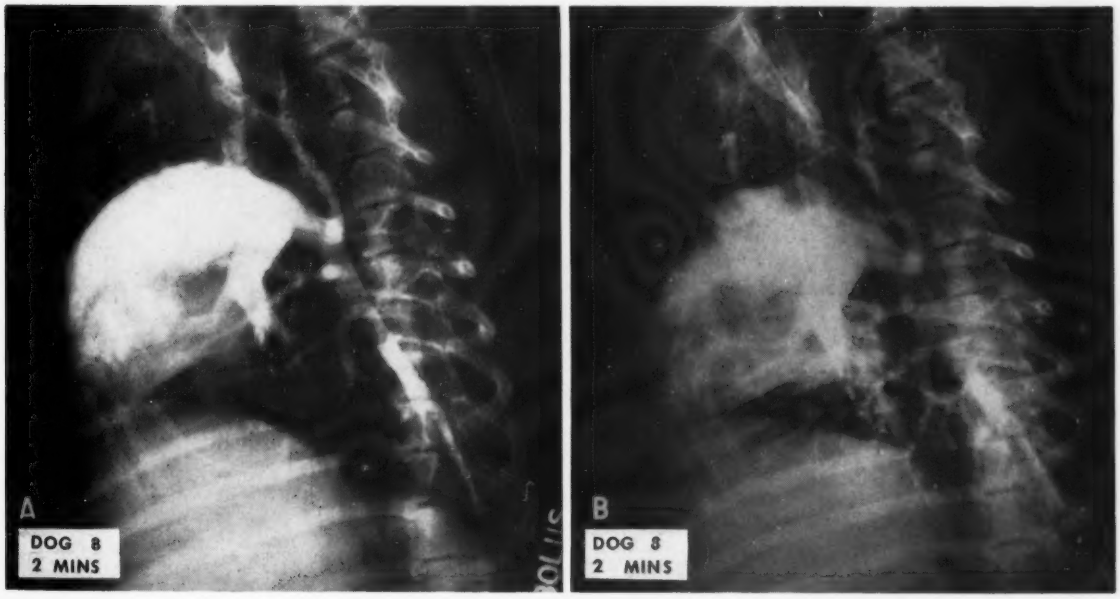

Fig. 3. *Partial segmental pulmonary arterial occlusion by experimental embolus (Dog. 8).* (*A*) Film selected from angiocardiogram made two minutes after release of embolus. The anterior, lateral and posterior basal branches of the right descending pulmonary artery are apparently occluded (compare with branches on the left). One second later (*B*) the vessels are filled, contrast agent having passed around the clot.

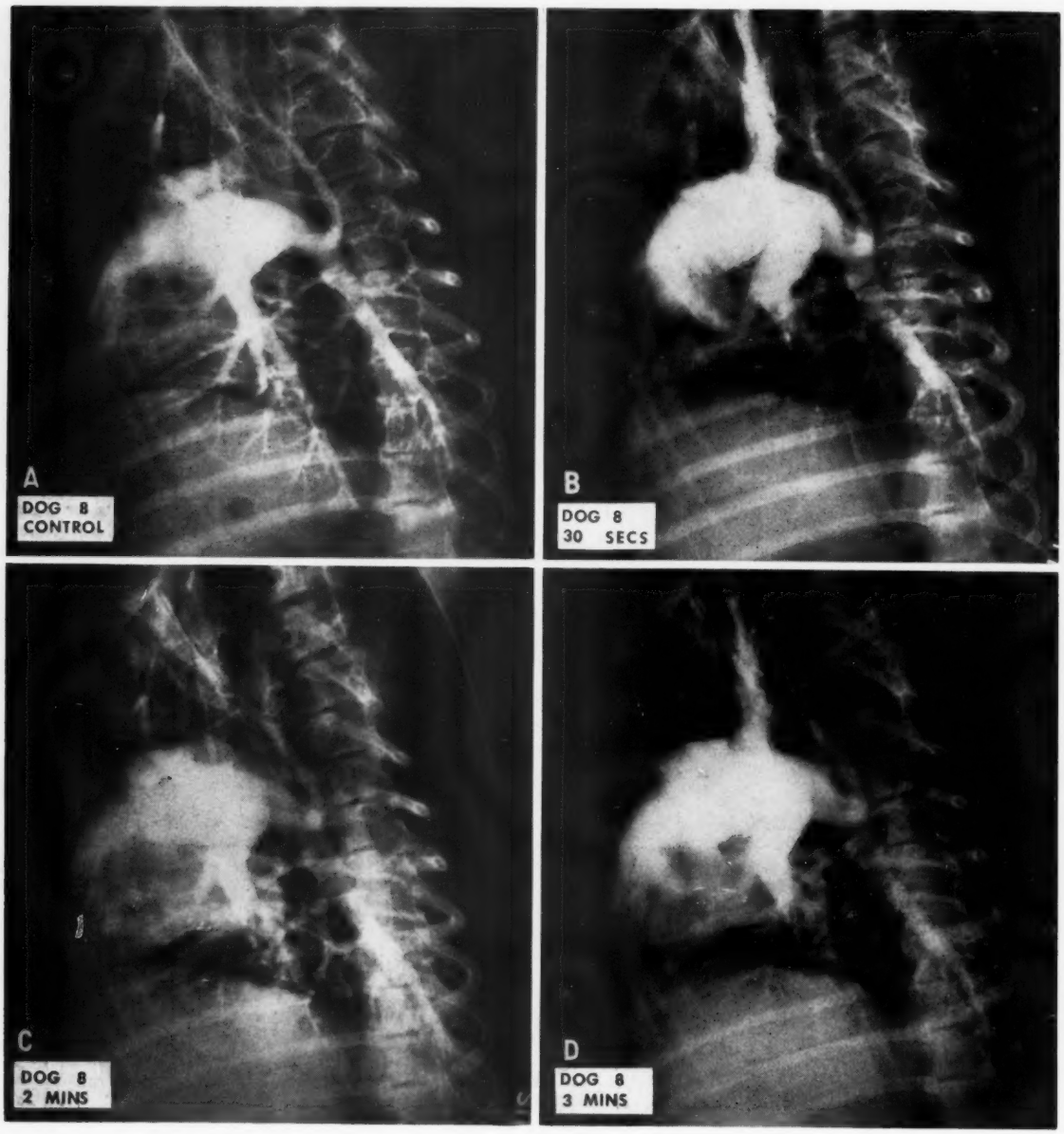

FIG. 4. *Pulmonary arterial dilatation following experimental pulmonary arterial embolism* (*Dog. 8*). Definite dilatation of the central pulmonary arteries began immediately after release of the embolus (*B*, *C*, *D*) and persisted for the duration of the study (five minutes).

the basilar branches. Complete obstruction did not occur in this animal and was an uncommon finding in these experiments. Instead, there could be seen a vague filling defect which resulted in delayed and diminished rather than absent opacification of the distal arteries (Fig. 3*B*). The clots never blocked the right or left main branch of the pulmonary artery but lodged in smaller lobar or segmental arteries, always in the lower lobes. The clot went to the right side in three experiments (Dogs 1, 5 and 8) and to the left in two experiments (Dogs 3 and 6).

The most striking finding in this study was the demonstration of pulmonary arterial dilatation beginning at thirty seconds and lasting for at least five minutes, the

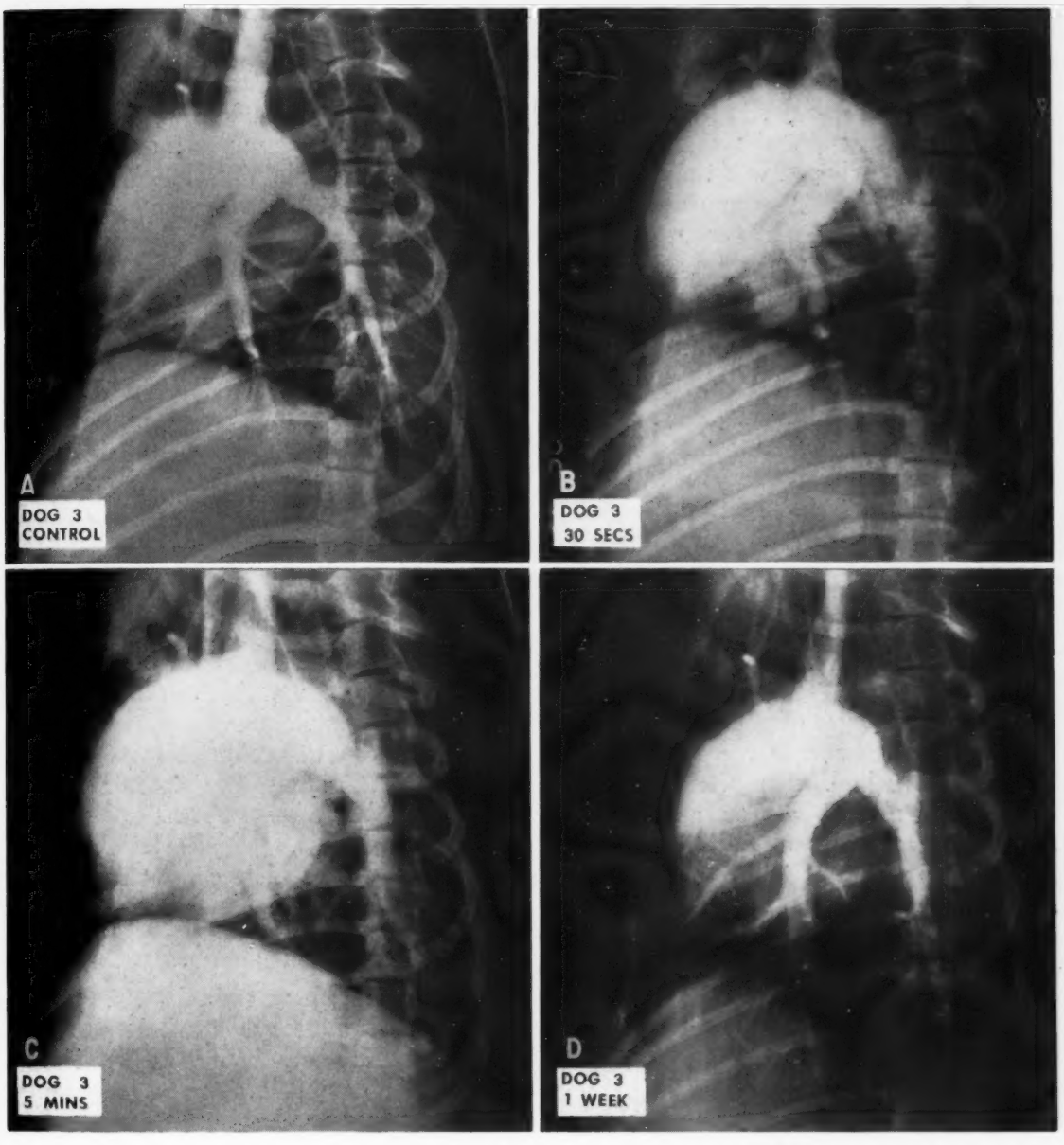

Fig. 5. *Pulmonary arterial and right heart dilatation following pulmonary embolization* (*Dog. 3*). A striking dilatation of the pulmonary arteries, the right ventricle and atrium and the superior vena cava developed immediately after release of the embolus (*B*, *C*). A week later the structures appeared normal (*D*).

period of observation (Fig. 4). The dilatation appeared to affect the larger arteries to a greater degree than the smaller branches, an impression which could not be reliably established by measurement. Measured central pulmonary arterial enlargement of a degree greater than that shown in control studies appeared in four animals (Dogs 3, 5, 6 and 8). This dilatation was marked in Dog 3, definite, although not marked, in Dogs 5 and 8, and slight in Dog 6. In one animal, Dog 1, there occurred no variation from the control study. Dog 3, which showed the most marked degree of dilatation, was re-examined angiocardiographically one week later at which time the pulmonary arteries and the right heart were normal in appear-

ance (Fig. 5). It was not possible to definitely correlate the degree of pulmonary arterial dilatation with the amount of mechanical obstruction produced by the clot. In Dog 6, although the dilatation was slightest, the occlusion was the most complete of the series. There appeared to be a transient decrease in caliber shortly after the initial dilatation. At no time was it possible to identify changes which were thought to demonstrate constriction of the pulmonary arteries.

The superior vena cava and cardiac chambers were grossly dilated in Dog 3 which also showed the most marked pulmonary arterial dilatation of this series (Fig. 5). Cardiac enlargment also occurred in Dog 5, but did not appear despite the presence of pulmonary arterial dilatation in Dogs 6 and 8.

DISCUSSION

This investigation entailed angiocardiographic observation of the pulmonary arteries and right heart in the dog following pulmonary embolization resembling that occurring in man. Death occurred as a result of the embolus in two out of six experiments. The clots used as emboli were of such a size as to lodge in tertiary, lobar or segmental branches of the pulmonary artery and were identifiable as filling defects or sites of occlusion of the affected vessels. In most cases the occlusion produced in a pulmonary artery by a blood clot was *not complete*, blood passing the clot more slowly and in reduced quantity. This fact offers an explanation for the rare occurrence of pulmonary infarction following minor pulmonary embolization (in the absence of passive congestion) in man.

In four out of five dogs, definite dilatation of the pulmonary arteries appeared by thirty seconds and lasted for the duration of the short period of observation. Vascular constriction could not be identified on the angiocardiograms. Marked dilatation of the heart which was reversible appeared in one animal. In the animal where death resulted from embolization and studies were available, moderate cardiac dilatation occurred.

During investigations preliminary to the present series of experiments, angiocardiographic observations were made following pulmonary embolization in eleven other dogs. Clots were formed in a manner similar to but not identical with the method described above. Angiocardiographic studies were conducted at various intervals during the hour following release of the emboli. Since uniformity of technique was not employed, these experiments are not reported in detail. One dog died almost immediately after embolization. In four animals no appreciable pulmonary arterial dilatation resulted. In the remaining six dogs, definite enlargement of the pulmonary arteries took place. The dilatation usually lasted for at least an hour but disappeared within twenty-four hours.

It is reasonable to assume that the observed dilatation was due to the right ventricular and pulmonary arterial hypertension known to occur following pulmonary emboli. The study does not explain the mechanism of this hypertension. It is possible that pulmonary arteriolar constriction occurs which cannot be recognized angiocardiographically.

The methods herein described present certain advantages in the experimental study of pulmonary embolism. The embolus itself is anatomically similar to that occurring in man, being a blood clot formed within a vein. The technique for the formation of the clot is simple and speedy and the thrombi are proportional in size to the animal in which they are formed. An outgrowth of the present study consisting of the addition of right heart catheterization and electrocardiography would be of interest.

CONCLUSIONS

1. Pulmonary embolism similar to that occurring in man was produced in the experimental animal. Angiocardiographic observations following acute pulmonary embolization in dogs were made, including

measurement of caliber of branches of the pulmonary artery.

2. Immediate dilatation of the central branches of the pulmonary arteries usually follows embolization of a lobar or a major segmental pulmonary artery. This dilatation may be reversible and is not necessarily associated with a fatal outcome.

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ESOPHAGEAL ULCER IN INFANCY*

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BLOODY vomiting or regurgitation by a newborn infant is a dire sign and a prompt search for the source and the cause is always begun. Since roentgen examination of the upper gastrointestinal tract can be done promptly and rapidly, involves very little risk to the infant and is highly accurate, the aid of the radiologist is the first to be sought. Elimination of an offending agent, supportive treatment or surgical intervention are required promptly and depend upon a precise diagnosis.

In the past, hematemesis in infants was attributed almost exclusively to bleeding duodenal or gastric ulcers and studies were directed to these areas. Rare tumors such as hemangiomas and hemangioendotheliomas were also considered. "More tardily, and chiefly by radiographic help," Wyllie and Field[16] state, "it has been recognized that vomiting—or rather regurgitation of coffee-grounds or bright red blood—may occur in the presence of esophagitis or of peptic ulcer at the lower end of the esophagus in cases of congenital short espohagus with partial thoracic stomach."

Peptic ulcer of the esophagus does not only occur where there is a congenitally short esophagus. Allison[1] feels that "It now seems nearer the truth to say that ulcer occurs where there is such a derangement of the mechanism of the cardia that acid gastric juice flows back easily into the lower end of the esophagus." Of 6 cases of intermittent esophageal regurgitation and hematemesis reported by Wyllie and Field[16] only 1 was due to a congenitally short esophagus. One was caused by stricture of the esophagus. The majority, 4 cases, was due to relaxation of the cardioesophageal sphincteric mechanism, with regurgitation of gastric contents leading to hemorrhagic esophagitis. Indeed, Smithers[14] believes a lax esophageal hiatus is the abnormality underlying the majority of cases diagnosed roentgenographically as short esophagus. Regurgitation of gastric contents produces irritation of the esophagus with resulting spasm of the longitudinal muscles fibers, shortening of the esophagus and partial intrathoracic stomach. Thus, he believes that what is called congenital short esophagus on roentgen examination is often a manifestation of disturbed physiology. This, he states, agrees with the fact that "true short esophagus is seldom found at post-mortem examination."

Pyloric stenosis may lead to peptic regurgitation into the esophagus. Following ligation of the pylorus in rats, Selye[13] noted regurgitation of acid gastric juice into the lower thoracic part of the esophagus where he found peptic hemorrhagic changes.

In addition to peptic esophageal ulceration by regurgitation, ulcers may be produced by peptic ferments formed within the esophagus by islands of ectopic gastric mucosa. In 1,000 consecutive autopsies of infants and children, Rector and Connerley[12] found aberrant gastric mucosa in 118 cases. It was found in the upper third in 51 per cent, in the middle third in 41 per cent and in the lower third in 8 per cent. The lower third of the esophagus therefore contained heterotopic gastric mucosa in only 0.9 per cent of the entire series. True peptic mucosal ulcers in the lower third of the esophagus must therefore be very infrequent.

Very rarely peptic ulcer of the esophagus is seen in conjunction with cerebral or cerebellar disease. Cushing[4] described a ten year old child operated upon for a cerebellar tumor in whom postmortem examination revealed a perforated ulcer in the esophagus measuring 3 centimeters in length. An autopsy on a patient operated upon for a right parietal lobe metastasis

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from a hypernephroma revealed both esophageal and gastric perforation.

Congenital varices of the esophagus are an extremely uncommon cause of regurgitation and hematemesis. Jorup,[8] in 1948, felt that only 3 or 4 reported cases met critical standards for this diagnosis. It produces small, early attacks of hematemesis. The varices, present from birth, are demonstrable by roentgenoscopic and roentgenographic examination. Farber[5] states that occasional cases of annular pancreas are associated with malformation of the portal region and produce a Banti type of obstruction with esophageal or gastric varices. Congenital Eck's fistula associated with portal obstruction, a very rare condition, may cause esophageal varices and bleeding.

In addition to these intrinsic lesions, regurgitation and bleeding of esophageal origin may be the result of direct trauma. Catheter feeding, or gavage, of premature infants is often adopted as a routine to save the strength and enhance the nutrition of these feeble babies. Although often life-saving, its use entails the danger of tracheal intubation with death by drowning or aspiration pneumonia; reflex apnea and circulatory collapse because of excessive handling; direct injury to the mucosa of the esophagus with ulcer formation. An example of the last-named complication—traumatic esophageal ulcer due to gavage feeding—has recently been reported in the Proceedings of the Clinico-pathological Exercises at the Massachusetts General Hospital.[3]

The present report is an account of a case of recurrent regurgitation and hematemesis in a premature infant in which an esophageal ulcer was diagnosed roentgenologically and confirmed by postmortem examination.

REPORT OF CASE

A female infant, weighing 1,540 grams, was born at the University of Minnesota Hospitals six weeks before term. The mother had had syphilis five years before, and was treated for one year with bismuth and arsenic preparations. A Wassermann test two months before delivery was negative but because of the past history she was given penicillin prophylactically starting one week before delivery.

The child breathed spontaneously at birth and appeared normal. The Wassermann test on blood from the umbilical cord was negative. The only abnormality noted was a small hard mass, measuring 1 mm. in diameter, just lateral to the fifth digit of each hand. She was placed in an incubator and received routine premature nursery care.

She did not take the nipple well and on the fourth day of life was started on feedings by medicine dropper. On the fifth day of life, the child began to have many loose stools with resulting dehydration. Two days later gavage feedings were begun but these were not well tolerated and were discontinued after forty-eight hours. Medicine dropper feeding was resumed but by the sixteenth day of life the child's weight had dropped to 1,450 grams. She then began to improve, took feedings well, gained weight and had a lusty cry.

On the twenty-eighth day the weight was 1,600 grams. Four days later there was regurgitation of some feedings, together with general decrease in activity. On the thirty-second day, coffee-ground material was regurgitated and this continued for the next eight days. On some occasions gross blood was noted. The white blood cell count was 15,100. The remainder of the blood count and the coagulation studies were normal. Several serological tests for syphilis were negative. Stool cultures were negative. The roentgenogram of the chest disclosed no abnormality.

On the forty-sixth day bloody emesis recurred, followed in a few days by frank diarrhea. Roentgenoscopic and roentgenographic examination after a swallow of iodized oil showed no evidence of obstruction or other abnormality of the esophagus. To rule out the possibility of intracranial hemorrhage as the cause of a gastrointestinal lesion, a subdural puncture was done but no abnormality was found. On the fifty-sixth day of life, roentgenologic studies of the esophagus were repeated, this time using barium sulfate as the contrast medium. There was narrowing at the cardia, dilatation of the thoracic portion of the esophagus and a persistent area of indrawing on the right side of the lower third of the esophagus (Fig. 1). At this level, on one of the spot films

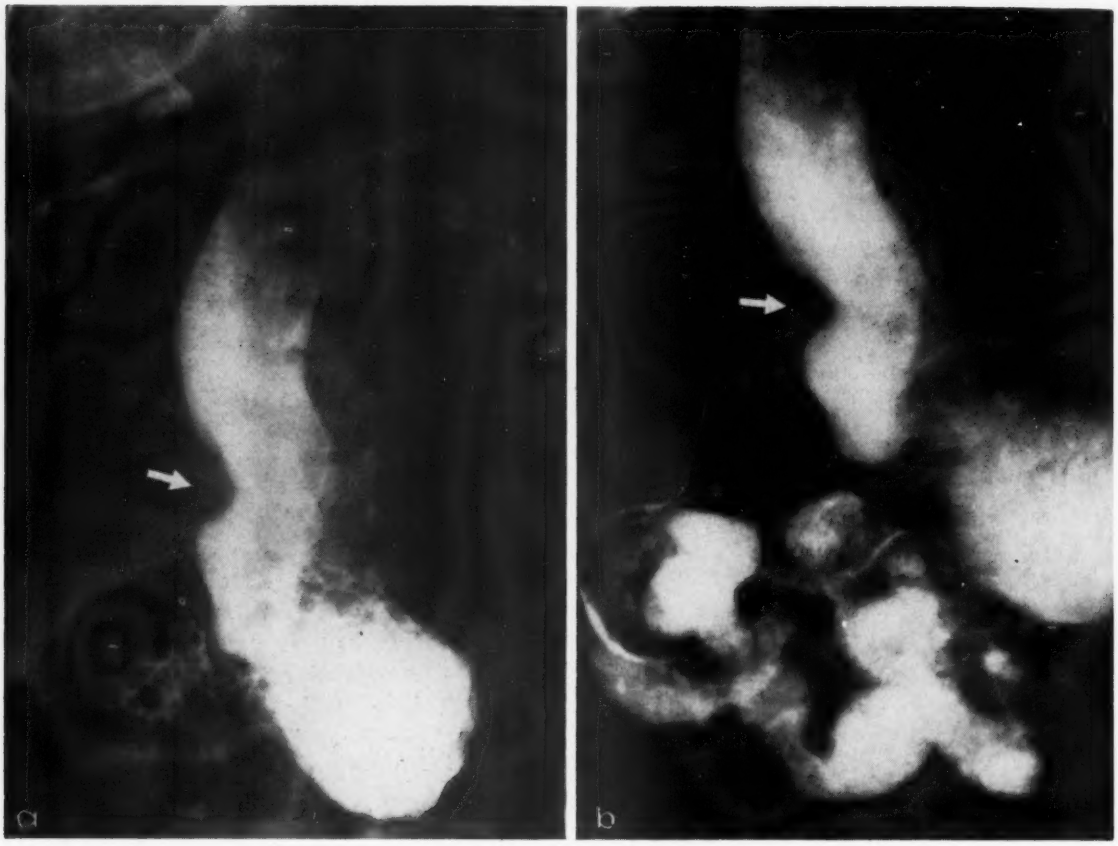

Fig. 1. The barium-filled esophagus is wide and there is narrowing at the cardia. Arrows indicate persistent spastic incisura.

(Fig. 2) an area, described as "highly suggestive of ulcer of the posterior wall, with an incisura opposite it" was seen. The dilatation of the esophagus was attributed to the cardiospasm associated with the ulcer. Two days later an attempt was made to pass a 20 French catheter into the stomach but this was unsuccessful. The infant's condition worsened and she died suddenly on the sixtieth day.

At autopsy, the esophagus was dilated and contained curdled milk. The trachea was displaced to the right. In the lower mediastinum, the esophagus was adherent to the medial aspect of the lower lobe of the right lung. At this point the esophageal wall contained a large perforated ulcer which communicated directly with the grossly consolidated lower lobe of the right lung. The floor of the crater revealed granulation tissue and scarring, with complete interruption of the muscular wall. Histological sections of the upper part of the esophagus revealed normal squamous epithelium and muscular layers.

The remainder of the body, including the brain, showed no evidence of abnormality and none of the stigmata of syphilis. The anatomical diagnoses were (a) esophageal ulcer with perforation, (b) bronchopneumonia, right lung, lower lobe.

DISCUSSION

As part of a large survey of neonatal pathology, Gruenwald and Marsh[6] reported a series of autopsied cases of esophagitis in infants, among which were several examples of frank esophageal ulcer. Two of the cases reported were anatomically similar to the present case in that newborn infants died of perforation of an esophageal ulcer into the right pleural cavity with resultant pneumothorax and pleuritis. Although none of their cases had been diagnosed roentgenologically, Gruenwald and Marsh suggested that the roentgen diagnosis would probably be made in a

fair number of instances if the lesion were thought of in all cases of hematemesis and if careful roentgenologic examinations were then made.

In Allison's[2] cases, the diagnosis of esophageal ulcer was based largely on the secondary signs of ulcer. He stated that actual demonstration of the crater is rare in esophageal ulcer as compared to gastric or duodenal ulcers. It was found in only 5 cases out of 74, taken at all ages.

Nørgaard[11] reports the case of a little girl, seen since the age of three, in whom the diagnosis of an esophageal ulcer crater was made at eight years of age. He states that the most common roentgenologic sign of esophageal ulcer is spasm of the involved area. The presence of a crater, in addition to the spasm, is pathognomonic, but several examinations were almost invariably required to demonstrate the niche.

Between 1936 and 1949, eight cases of esophageal ulcer in children under five years of age were seen at the University Hospital in Copenhagen.[15] Symptoms, in all cases, had been present from birth or had appeared during the first months of life. The number of cases in which a niche was demonstrated is not given but, out of the larger group of patients of all ages, it was found in 21 out of 27 cases. Several examinations were frequently required.

The roentgenological findings in the present case are remarkably like those described by Lesne *et al.*[9] and Guenaux[7] and Marquezy and Royer.[10] The former authors[7,9] report the case of a child who vomited blood-tinged material after every meal during the first days of life. Roentgenographic examination revealed "an intense spasmodic contraction deeply indenting the left border of the esophagus and producing below it a diverticulum-like protrusion." They felt that the incisura here had the same significance as an incisura of the greater curvature of the stomach in peptic ulceration of the lesser curvature. Ten months after the first examination, following treatment with bismuth and antispasmodics, a second roentgenographic examination revealed an esophagus of

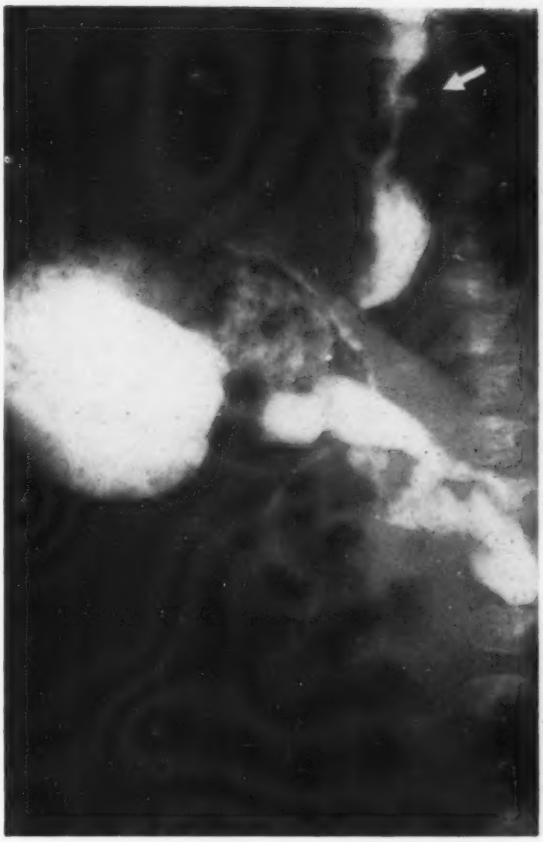

Fig. 2. Left posterior oblique film. Arrow indicates niche on posterior wall of esophagus at the level of the incisura.

normal caliber with only a slight smooth retraction in the zone of previous ulceration. The authors conclude: "We therefore feel justified in maintaining our diagnosis of ulceration of the supradiaphragmatic portion of the esophagus present since birth. The medical literature does not furnish us with any other examples of this lesion."

Marquezy and Royer[10] described a ten month old boy who had vomited intermittently since birth. Finally, hematemesis occurred and the child died. Postmortem examination was not done. Roentgenograms had shown a spastic incisura above a niche on the left border of the supradiaphragmatic part of the esophagus. Referring to the preceding report, the authors considered this to be another case of ulcerative esophagitis.

In neither report was a history of gavage feeding given nor was any other cause for

the ulceration suggested. In the case here described the cause of the ulcer is also not apparent. There are no roentgenographic signs of congenital brachyesophagus, partial intrathoracic stomach or diaphragmatic hernia. Postmortem examination of the brain affords no evidence of a neurogenic origin of the ulcer. Aberrant gastric mucosa was not found in the esophagus.

However, the natural history of this case is decidedly similar to the case reported from the Massachusetts General Hospital as a traumatic ulcer of the esophagus produced by gavage feeding. In their report, Castleman states that the ulcer "did not have the fibrinoid base characteristic of a peptic ulcer. . . . I believe that it can be wholly explained on the basis of the gavage tube." They were not able to find out exactly how often the gavage tube was used nor how long it had been kept down as the child had been at another hospital. Their information was that it was used "many times and was kept down for varying lengths of time." In the present case, the crater also did not have a fibrinoid base but this by no means rules out peptic ulcer with certainty. Gavage feeding was carried out for two days, but it is difficult to determine how much trauma is necessary to produce ulceration.

The French cases and the present case are among the youngest patients with esophageal ulcer diagnosed roentgenologically. The former were not confirmed; the latter was verified at autopsy. These examples reveal a distinct crater and a sharp incisura in all likelihood because there has not been enough time for much fibrosis or infiltration.

SUMMARY

Pathological and clinical studies indicate that esophageal ulcer in infancy, although a rare lesion, is more common than previously believed. Hematemesis is the cardinal sign. Roentgenologic examination should be done in every case and repeated studies are usually necessary to demonstrate the crater. An example of ulcer of the esophagus in a newborn infant, diagnosed by roentgenologic examination and verified at autopsy, is presented. The possibility of antemortem roentgen diagnosis is emphasized.

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Vol. 68, No. 4

SILICOBEZOAR

REPORT OF A CASE

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THE literature on bezoars, other foreign bodies and concretions in the stomach and/or upper gastrointestinal tract is impressive, dating back into antiquity and mythology. DeBakey and Ochsner,[2] mentioned also by Osmond and Price,[3] have covered the subject in a thorough manner, reflecting upon unusual types of bezoars, the mythological uses of some of them, the "raison d'être" for many of them, and their treatment, They classify the several varieties of bezoars according to their composition as:

1. Trichobezoars (pilobezoars, hairballs).
2. Phytobezoars (hortobezoars), from plant material.
3. Trichophytobezoars (combination of the above two).
4. Concretions (shellac, etc.).

Perhaps a subheading could be included under (4) in this classification, *i.e.*, that of sand, clay, asphalt, etc. Then there are, of course, the many and varied types of foreign bodies, which, if small and numerous enough, could constitute a bezoar.

Davies[1] reported the case of an asphalt bezoar in an Iranian laborer, aged twenty-one, of obviously low I.Q., who vomited copiously after a solid meal but not if fluids alone were taken. A hard black mass, 4 inches long, weighing 30 grams, was removed at operation. It consisted of asphalt in which were embedded many pomegranate seeds. The patient, an asphalt worker, had been in the habit of chewing asphalt. This habit was said to be common in asphalt plants in England. Other cases had been found.

There was a case reported by Wheeler,[4] of a forty-three year old, mentally ill, former railroad telegrapher, at Brattleboro (Vermont) Retreat, who, over a period of six years and three different and separate operations, had at least 1,300 foreign bodies, total weight 950 grams, removed from his stomach. The foreign bodies ranged all the way from tacks, hairpins, razor blades, screws, nails, etc., to small and large pieces of broken glass. The sharper objects had been enfolded in chewing gum prior to ingestion.

In many of the cases reported by DeBakey and Ochsner,[2] doubtless in many others not reported, and in the one above reported by Wheeler,[4] ulcers were found, most of them being on the lesser curvature of the stomach, near the pylorus. Osmond and Price[3] reported a case of giant hairball (trichobezoar), with perforated ulcer on the lesser curvature of the stomach in a patient who recovered after operation for the bezoar and closure of the ulcer. They consider the case unusual, for recovering, following perforation of an ulcer associated with giant trichobezoar.

Another case is herewith reported, of a giant "silicobezoar" (classification?), with large ulcer on the lesser curvature of the pyloric antrum, which was operated upon, first, for the bezoar, second, for a gastroenterostomy to relieve pyloric stenosis and finally to explore and confirm the existence of massive and metastatic gastric carcinoma.

CASE REPORT

A white, Finnish female, aged sixty-nine, was admitted to the hospital on May 31, 1950, with complaints of pain in epigastrium, radiating up into the throat, anorexia, vomiting (dark black stuff) after a little food, tarry bowel movements with laxative, weakness and dry tongue. The patient had felt "poorly" all winter (since September, 1949) with pedal edema, weakness, pallor, anorexia, fatigue and weight loss. She had been under the care of a

Fig. 1. Flat film of abdomen, showing homogeneous mass density in left abdomen.

physician for heart disease. Epigastric pain had been present most of the time, not related to food except sometimes relieved, sometimes accentuated by food. She slept well, never on her back, due to epigastric pain, but on one side or the other. There was no other nocturnal pain, no cough, dyspnea, or orthopnea. Occasionally chest pain was present.

The patient had prior hospital admissions, *i.e.*, on March 15, 1942, for large pendulous midline ventral hernia, falling down over the anterior abdomen as an apron. The contiguous skin margins of this hernia were ulcerated and macerated. This had been increasing gradually in size since her last pregnancy. She was sixty-one at this time. The hernia was repaired and she recovered uneventfully, being discharged on April 2, 1942—an eighteen day hospital stay. She was again readmitted, on July 21, 1942, for epigastric pain, nausea and gas (belching and flatulence) and dyspnea. The condition was thought to be an acute gallbladder upset and she was discharged on July 22, 1942, as "cured" with a diagnosis of possible intestinal adhesions, and possible gallbladder.

On the admission of May 31, 1950, the patient had normal temperature, pulse and respiration, blood pressure of 138/64, weight 121¼ pounds. There were a few roots of teeth in her lower jaw, but she was otherwise edentulous. The mucous membranes and conjunctivae were pale. She herself was thin, pale and emaciated. The rest of the physical examination was essentially negative except for a small thyroid adenoma in the mid-portion of the gland, and a large hard, movable mass which could be felt, outlined by palpation, and seen in left upper abdominal quadrant. The abdomen was but moderately distended and tympanitic. Pelvic and rectal examinations and chest roentgenoscopy were negative. Laboratory examinations were essentially negative except for marked secondary anemia with some anisocytosis, poikilocytosis and hypochromasia. A flat film of the abdomen (Fig. 1) showed a large mass density, size and shape of the dilated stomach in the left abdominal quadrant. No history at this time was available (patient could not speak English), and it was thought that perhaps the patient had been given some barium elsewhere. When, however, this was disproved, a diagnosis of bezoar, type undetermined was made. The diagnosis was questioned and in view of the abdominal distention, epigastric

Fig. 2. Attempt at barium enema with barium stopped near splenic flexure (evacuation film). A small swallow of barium outlines the gastric cardia with contrasting density in gastric fundus.

pain, tarry stools, etc., a barium enema examination was carried out, somewhat unsuccessfully, but the radiologist gave some barium by mouth before making the roentgenogram (Fig. 2), which showed the enema flowing as far as the lower colon, where it was stopped, since the patient was in poor condition and the rectosigmoid was dilating alarmingly. The barium by mouth, however—just a small swallow—outlined the gastric cardia with marked contrast to the opacity in the lower fundus of the stomach which, at this time, had gravitated to the right and across the midline.

The diagnosis of bezoar was agreed upon, the patient was given a transfusion, and under pentothal, cyclopropane and curare, a gastrotomy was done on June 8, 1950, and 2½ pounds (dry) of sand were removed (Fig. 3 and 4). The stomach was markedly dilated, slightly edematous on the lesser curvature but was smooth and did not have the consistency of a malignant lesion. There was an area of ulceration on the lesser curvature of the pyloric antrum, though due to pressure and friction, the pylorus was wide open and larger than usual, and, except for small scyballous masses, felt here and there in the small and large intestinal tract and a few adhesions, the abdomen was essentially

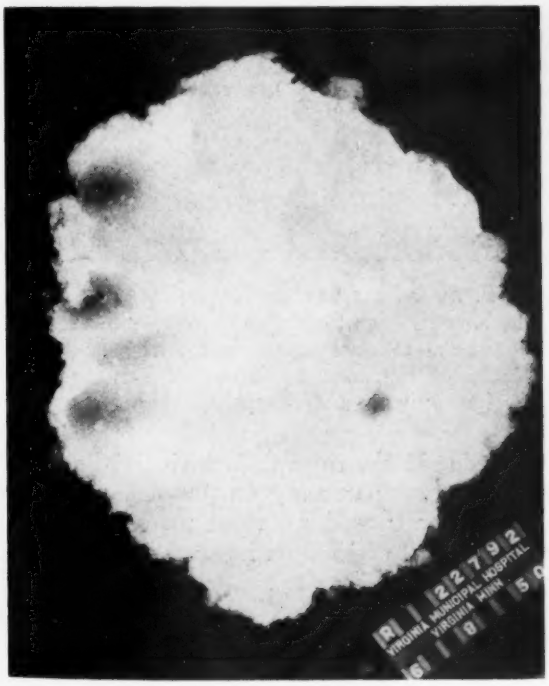

Fig. 3. Roentgenographic view of sand, spread out on cassette.

Fig. 4. Dry sand, in quart mason jar, removed from patient, weight 2½ pounds.

normal. Following surgery the course was relatively uneventful. The bowels moved after castor oil and the patient was eating in a week. She was discharged on June 19, 1950, eleven days after operation, with a diagnosis of silicobezoar, secondary anemia, arteriosclerotic cardiovascular disease and probably aortic stenosis.

The patient was readmitted on June 22, 1950, because of lower abdominal pain and vomiting. The anemia had somewhat improved. Other laboratory tests were negative. Films showed sand still present in the lower half of the colon, the stomach was dilated and the patient was vomiting. After repeated gastric lavages and transfusions an anterior gastroenterostomy was done on July 1, 1950. Roent-

FIG. 5. Flat film of abdomen, showing 40 per cent twenty-four hour gastric retention of barium in most dependent portion of gastric fundus. (Sponge is *not* in abdomen, but is external dressing.)

genogram taken on July 13, 1950, with barium in the stomach (Fig. 5), showed a 40 per cent gastric retention after twenty-four hours in the most dependent portion of the stomach. She finally improved, however, under repeated gastric lavage; the bowels were moving with the help of castor oil, she was eating and retaining food, and she was again discharged on July 25, 1950, with a diagnosis of prepyloric gastric ulcer with obstruction, gastric and intestinal atony, improved.

On December 20, 1950, an upper gastrointestinal tract examination showed (Fig. 6), on the four hour film, all the evidences of a gastric carcinoma of a scirrhous type, with masses surrounding the pars media of the stomach, a mass in the liver and a functioning gastroenterostomy. The examinaiton was difficult because of the poor condition of the patient and lack of ability to cooperate. Other changes, of course, associated with her advanced years, were present.

On December 29, 1950, about six and a half months after removal of the silicobezoar, and about six months after gastroenterostomy, the patient was again admitted to the hospital with weakness, anorexia, anemia, epigastric and left upper abdominal discomfort, and constipation. She had gained some weight and strength since her last discharge but had not eaten well. The anemia was refractory to anything but transfusions. She also complained of a mass overlying the liver in the upper mid-abdomen. The heart was enlarged to the left, the right and left lobes of the liver were markedly enlarged and palpable, there was a rounded mass, 4 cm. in diameter in the upper mid-abdomen which could be displaced up under the xiphoid process, and there was a smaller but no less palpable mass under the

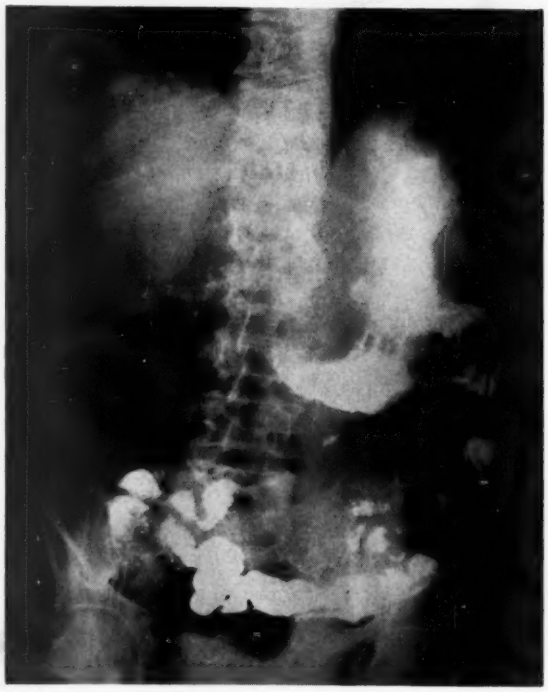

FIG. 6. Four hour flat film of abdomen following barium by mouth showing gastroenterostomy, masses about pars media, in the liver area, evidence of scirrhous carcinoma of the stomach, barium in ileum and arteriosclerotic aorta.

liver edge in the right mid clavicular line. An exploratory laparotomy on January 5, 1951, showed the liver down three finger breadths, several small nodules on its surface with some palpable in the liver substance. One nodule on the left lobe of the liver measured 6 by 4 cm. and was smooth, firm and whitish in color. There were numerous aortic nodes, some, 4 cm. in diameter. The stomach was fixed, thickened, and along the lesser curvature, at

about the site of the previous ulcer, was a large thickened, puckered, firm, hard, fixed mass. Numerous other nodular masses were noted throughout the abdomen and above the level of the liver. The gallbladder was small and contained calculi. The suture line of the previous gastroenterostomy was adequate. The patient was discharged to the convalescent Pioneer Infirmary on January 15, 1951, with a diagnosis of carcinoma of the stomach with metastases. She died on January 23, 1951. Autopsy was not obtained.

DISCUSSION

Late in the above patient's last illness sufficient interest was aroused to elicit information that she ate sand as a child, and some in the fall prior to her May 30, 1950, admission. There is said to be an old Finnish custom of eating sand for indigestion and/or constipation. Perhaps, if little is ingested, it passes through without harm but continued use of any large amount could probably cause enough irritation to produce an ulcer, similar to those caused by other types of bezoars. Certainly a large amount of sand collecting in the stomach is sufficient to cause chronic irritation which could conceivably lead to carcinoma, as in this case. Advanced age and arteriosclerosis doubtlessly unfavorably influenced this case. One is led to wonder just how long the stomach had been full of sand and how many of the patient's earlier symptoms might have been connected therewith.

CONCLUSIONS

A brief review of the literature on bezoars and concretions in the stomach is presented, together with a case report on an unusual type of bezoar to which the term "silicobezoar" might be applied; the patient developed ulceration and carcinoma, most likely secondary to the bezoar. Roentgenographic findings were proved surgically.

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BIOLOGICAL EVALUATION OF SKIN EFFECTS OF THE 23 MEV. BETATRON*†

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MOST radiation therapy of cancer is limited by the tolerance of the skin through which the beam passes to reach the cancerous area. General tolerance levels have been established for conventional radiations, and individual variations frequently dictate less or permit more than average doses. The theoretically low entrance surface skin dose calculated for the betatron roentgen-ray beam has deprived us of a very important gauge in determining a maximum tolerance dose even for deeper tissues than skin. In spite of it the skin effects cannot be neglected in the therapeutic use of the betatron. It is important to know the relative sensitivity of the skin to the high speed energy, also cognizant that the cancerocidal dose runs parallel to the epidermolytic dose to a certain degree.

Although the dose of roentgen rays from the betatron can be measured with the usual roentgen meters, the readings obtained cannot be readily correlated with doses obtained in lower voltage ranges. The same total energy absorbed from beams of low and extremely high voltage roentgen rays produce different amounts of ionization in chambers. The difference in the energy absorbed per gram roentgen in water from 200 kv. and 23 mev. roentgen rays has been calculated as slightly less than 10 per cent. The difference in average specific ionization accounts for a real difference in biological effect per energy absorbed.

As shown by Lea,[4] and others, the biological effect of radiation for the same amount of energy absorbed will vary with density of ions along the path of the ionizing particles. Since the average specific ionization of the secondary electrons produced in tissue by the absorption of 200 kv. roentgen rays is somewhat greater than for 23 mev. roentgen rays, it is to be expected that for the same number of ergs absorbed per gram of tissue, the biological effect with the lower voltage roentgen rays may be greater.

Quastler and his associates[2,13,15,16,17] have done a great deal of work on the ratio of physical doses measured with ionization chambers to obtain biological equivalence. Their work on survival time in mice after total body irradiation, graying of hair in mice, stunting of growth in beans, and sex-linked mutations and eye facet counts in *Drosophila* indicates ratios of about 75 per cent between the effects of 20 mev. peak and 200 kv. peak roentgen-ray beams.

We have been testing the skin of rabbits mainly and humans to a lesser extent.[1,3,4,5,6,8,9,18,20] There are considerable data available in the literature on lower voltage irradiation effects in rabbits, but there is lack of uniformity due to various techniques, different areas of the body used, different criteria for establishing epilation and erythema levels, and seasonal variations in erythema and epilation.

Therefore, we started with conventional roentgen-ray voltages, using 100, 200, and 400 kv. (peak) roentgen rays for orientation. On the basis of these preliminary experiments, we have omitted anesthesia, we have shaved the observed areas to avoid the filter effect of hair and to permit more accurate observation of the skin effects. Age, seasonal and litter differences, and also a seasonal rhythm in connection with epilation doses were observed, probably related to shedding and hair growth. We have noted greater reactions and greater variability with the same skin dose on large

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† This investigation was supported in part by a research grant from the National Institutes of Health, United States Public Health Service, and instrumentation was provided by a grant from the American Cancer Society.

fields where decreased recovery, transient vasomotor responses, inflammations, and necrotizing infections with *Staphylococcus aureus* confuse the effect. Erythema and epilation effects do not always proceed in parallel fashion, and therefore must be observed as separate effects. Frequently thicker and longer fuzzy hairs are seen on the margins of the epilated areas (Fig. 1 and 2). These grow much faster than the hairs elsewhere and are probably an overrecovery of slightly damaged hair follicles rather than true stimulation. The epilation usually appears later than the erythema and both reactions later than in humans. Generally one must observe the reactions for three months or longer.

These preliminary experiments for orientation were followed by comparative irradiations with 200 kv. and 23 mev. of the betatron, respectively. Young adult white rabbits were used averaging 5 pounds in weight. To immobilize the rabbits without anesthesia, they were tied to a holder with adjustable parts constructed for this purpose (Fig. 3). The same holder was used also for irradiation of other body parts and of other animals, *e.g.*, monkeys.

The lateral surface of the hind legs was used for all of the work, and the animal positioned so that the beam did not pass into deeper organs. On both sides three circular fields of 1 cm. diameter each were irradiated (Fig. 4 and 5). The irradiated area was marked with tattoo signs. The right leg was exposed to the 23 mev. roentgen rays of the betatron at 80 cm. target skin distance, 120 r/min. and symmetrical fields of the left leg were exposed to 200 kv. roentgen rays with 40 cm. target skin distance, 0.75 mm. Cu half-value layer 0.5 Cu plus 2 mm. Al inherent filter only, 25 ma., and 80 r/min. (skin dose). No local shielding was used with the betatron since the collimator in the machine gave a sharply defined 1 cm. field. However, a 4 cm. water equivalent thick block of lucite was placed tightly on the skin so that the 100 per cent or maximum dose level beam would be at the skin depth.

Fig. 1. 100 kv.; upper field 3,400 r skin dose; lower field 3,000 r skin dose. Six months after irradiation—overgrowth of hair on the margin of the epilated areas.

Single fields had to be treated separately with the betatron, but three fields were easily covered simultaneously with the 200 kv. roentgen-ray beam. Both sides were usually treated on the same day. The number of "roentgens" measured in

Fig. 2. 200 kv.; upper field 2,650 r skin dose; middle field 1,600 r skin dose; lower field 1,300 r skin dose. Three months after irradiation—the epilated areas are obscured by the marginal overgrown overlying thick hair.

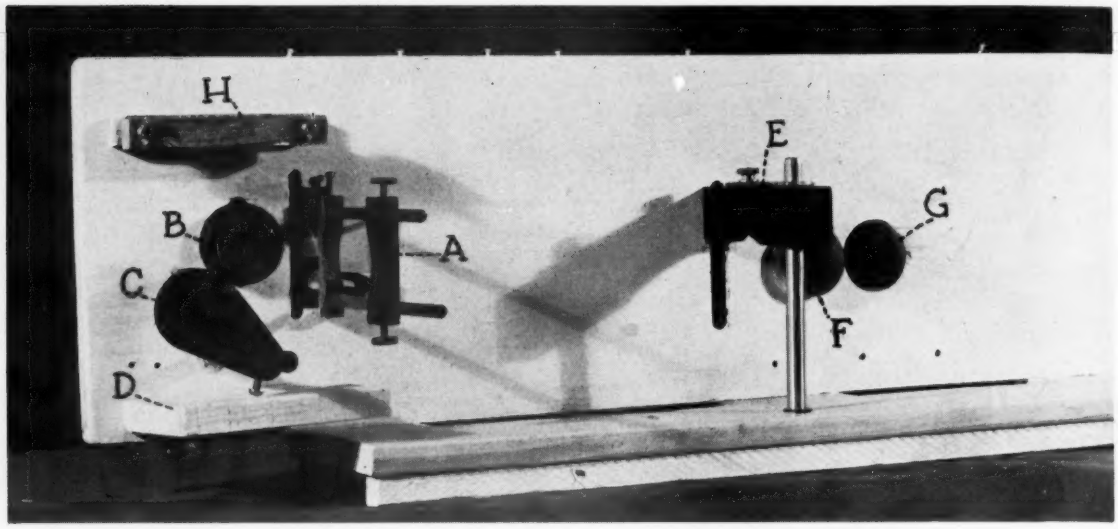

Fig. 3. Animal holder. (*A*) Adjustable holder of the neck. (*B*) Support for the head—bakelite ring covered with a thin transparent lucite plate for exact localization of conventional roentgen rays. It can be substituted by a lucite plug (*F*) for betatron irradiation. (*C*) Plate for immobilization of the head. (*D*) Wood plate for forepaws of the animal. (*E*) Adjustable holder for the body of the animal. (*F*) 4 cm. thick lucite plug for irradiation with betatron. (*G*) Hole for adjustment of (*F*) if necessary. (*H*) Holder for the ears of rabbits.

these betatron experiments was determined essentially in the same way as in previous work by Quastler. A 25 r Victoreen thimble chamber was exposed inside a lucite block in which the center of the chamber was at the depth of maximum dose. It has been shown that the dependence of the intensity of this radiation on distance from the target follows the inverse square law. Accordingly, it was convenient with the 1 cm. diameter beam (at 80 cm.) to make the thimble chamber measurements at 4 meters distance to insure that the chamber would be irradiated by a sufficiently large field to avoid edge effects and then convert these readings to the distance at the skin of the rabbit behind the lucite block.

The fields were irradiated with different skin doses from 800 r to 6,600 r. The first group of animals received the same physically measured dose at both wavelengths. The smallest dose given with 200 kv.

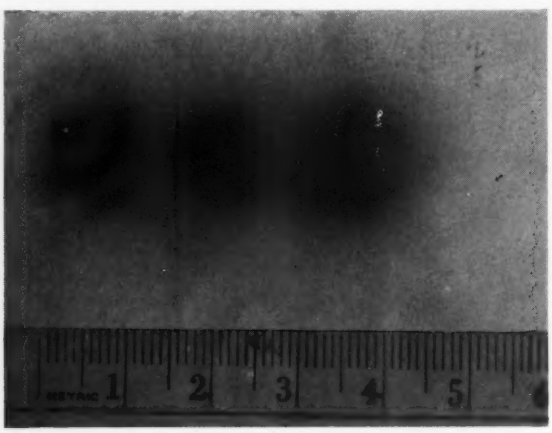

Fig. 4. The three fields, exposed on the exit surface during irradiations with the betatron.

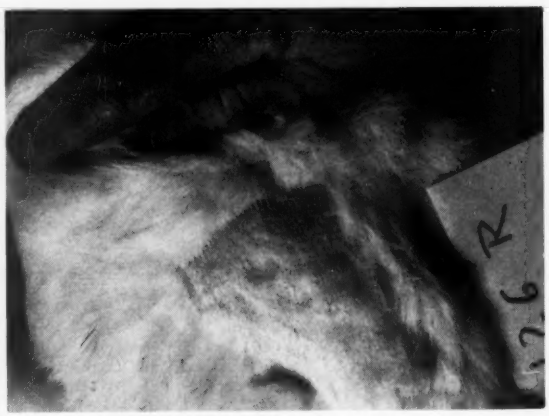

Fig. 5. The three epilated fields with doses of 3,800, 2,500, and 2,000 r with the betatron after three months.

resulted in an effect which frequently exceeded that from the highest dose given with the betatron; therefore, a ratio could not be established in these animals. The number of individual comparisons for the efficiency is, therefore, smaller; the number of individual data are less satisfactory than the collective data. Subsequently the betatron doses were increased 30 per cent over those given from a 200 kv. source in order to approach a ratio of unity. Disregarding all of the orientation tests, and those made on animals which died of intercurrent diseases, ninety irradiations could be followed to completion.

The reactions were observed daily comparing the two sides of each animal. The chief problem was how to register the observations so as to have a true and quantitative picture of all the phases of the reaction. For uniformity, a single examiner (L.L.H.) made the observations and recorded all of the phases, degrees and intervals of the changes in a form suitable for graphical registration and evaluation. The working observations were graded for erythema as follows:

1. No erythema.
2. Minimal doubtful pink spot without definite boundary. It can be considered first trace of reaction only if development continues.
3. Similar indistinct pink spot, but with defined borders and still below what might be considered threshold erythema.
4. Very slight but well defined hyperemia, which disappears without a trace in a few hours to one or two days. Threshold erythema.
5. Mild erythema exceeding the threshold erythema but not reaching the intensity of a standard erythema.
6. Erythema to conform with the standard reaction of the S.E.D. It regresses with a superficial dry scaling or crusting, and after a few weeks is barely detectable as slight atrophy of the skin.
7. More marked reaction of longer duration and slower regression.
8. Marked erythema, with thick crusts, deeper involvement, no oozing, and slow regression. Atrophy appears immediately after healing and is more marked.
9. Oozing epithelitis.
10. Necrosis.

For tabular purposes the above observations were grouped as follows:

A. No definite reaction (1, 2, 3 of foregoing groups).
B. Suberythema: threshold erythema and mild erythema (4 and 5 of foregoing grades).
C. Erythema (6).
D. Hypererythema (7 and 8 of foregoing grades).

Similar eight grades were recorded for individual observations of the epilation. For tabular purposes the epilation observations were reduced to four categories:

A. No epilation.
B. Partial epilation (subepilation).
C. Complete epilation.
D. Hyperepilation: Epilation with atrophy of skin and hair follicles without chance of regrowth of hairs.

In Group B the epilation is usually temporary; in Group C the epilation was in a part of the cases unexpectedly permanent.

The *comparison of* physical doses and equivalent *biological effectiveness* of low and high voltage beams was accomplished:

I. By collective comparison of effects of different doses at the different voltages on all animals, and
II. By individual comparison of effects on single animals.

Collective comparisons of erythema effect are shown in Table 1. It shows the doses of 200 kv. roentgen rays which produced various degrees of erythema: 800 r skin dose produced a threshold or suberythema in half of the irradiations; 1,000 r skin dose produced it in nearly every case. 950 r skin dose reached in more than half of the cases the standard erythema, and 1,500 r in every case. 1,250 r produced hypererythema in half of the cases, and 1,800 r in nearly every case. Oozing epithelitis appeared above 3,300 r skin dose and necroses above 4,300 r only on larger

TABLE I

COLLECTIVE DATA FOR ERYTHEMA

Dose in roentgens	200 kv.				Betatron 23 mev.				η (betatron 23 mev. @ 200 kv.)
	No. of cases	No. of Reactions at least	Per cent of Reactions at least	In 50% of cases dose of	No. of cases	No. of Reactions at least	Per cent of Reactions at least	In 50% of cases dose of	
		Suberythema				Suberythema			
800	10	5	50.0		3	—	—		
1,000	13	12	91.5		9	1	11.1		
1,200–1,300	21	20	95.0		15	6	40.0		
1,500–1,600	23	23	100.0		18	10	55.5		
1,800–2,000	13	13	100.0		11	10	90.9		
2,200–2,600	4	4	100.0		14	14	100.0		
				800 r				1,400 r	0.57
	Erythema				Erythema				
800	10	—	—		12				
1,000	13	8	61.5			—	—		
1,200–1,300	21	18	85.7		15	1	6.7		
1,500–1,600	23	23	100.0		18	6	33.3		
1,800–2,000	13	13	100.0		11	9	81.8		
2,200–2,300	4	4	100.0		8	7	87.5		
2,500–2,600					6	6	100.0		
				950 r				1,700 r	0.56
	Hypererythema				Hypererythema				
800	10	—	—		12	—	—		
1,000	13	1	7.7			—	—		
1,200–1,300	21	12	57.1		15	—	—		
1,500–1,600	23	21	91.3		18	—	—		
1,800–2,000	13	12	92.3		11	4	36.4		
2,200–2,300	4	4	100.0		8	3	37.5		
2,500–2,600					6	4	66.7		
2,700–3,100					6	4	66.7		
3,300–3,500					4	4	100.0		
3,800–6,600	6	6	100.0		10	10	100.0		
				1,250 r				2,350 r	0.53

fields of 20 sq. cm. On fields of 1–1.5 cm. diameter 4,500 r did not produce oozing. Where it was necessary, the experimental points were plotted and the 50 per cent value determined by graphical interpolation. Cold weather requires the addition of at least 5 per cent to these levels, and hot weather reduces them by 5 per cent. The doses of 23 mev. betatron roentgen rays necessary to produce the same intensity of reactions are also shown in Table 1: 1,400 r produced a threshold or suberythema in half of the cases, 1,800 r in nearly every case. The dose for standard erythema was found in half of the cases as 1,700 r. 1,800 r produced a hypererythema in about one-third of the irradiations. Hypererythema developed in half of the cases with

TABLE II

COLLECTIVE DATA FOR EPILATION

Dose in roentgens	200 kv.				Betatron 23 mev.				η (betatron 23 mev. @ 200 kv.)
	No. of cases	No. of Reactions at least	Per cent of Reactions at least	In 50% of cases dose of	No. of cases	No. of Reactions at least	Per cent of Reactions at least	In 50% of cases dose of	
		Subepilation				Subepilation			
800	10	3	30.0		3	1	33.3		
1,000	13	12	92.3		9	3	33.3		
1,200–1,300	21	20	95.2		15	8	53.3		
1,500–1,600	23	22	95.6		18	10	55.5		
1,800–2,000	13	13	100.0		11	10	90.9		
2,200–2,600	4	4	100.0		14	14	100.0		
				850 r				1,200 r	0.71
	Epilation				Epilation				
800	10	—	—		3	—	—		
1,000	13	7	53.8		9	—	—		
1,200–1,300	21	17	80.9		15	3	20.0		
1,500–1,600	23	21	91.3		18	9	50.0		
1,800–2,000	13	13	100.0		11	10	90.9		
2,200–2,600	4	4	100.0		14	13	92.9		
2,700–6,600	6	6	100.0		20	20	100.0		
				1,000 r				1,500 r	0.67
	Hyperepilation				Hyperepilation				
800	10	—	—		3	—	—		
1,000	13	5	38.5		9	—	—		
1,200–1,300	21	12	57.1		15	—	—		
1,500–1,600	23	21	91.3		18	3	16.7		
1,800–2,000	13	12	92.3		11	7	63.6		
2,200–2,300	4	4	100.0		8	3	37.5*		
2,500–2,600					6	5	83.3		
2,700–3,100					6	5	83.3		
3,300–3,500	6	6	100.0		4	3	75.*		
3,800–6,600					10	10	100.		
				1,150 r				1,750 r	0.65

* These two values have been disregarded due to technical insufficiencies: *i.e.*, moving of two rabbits during irradiation.

2,350 r. On 1 cm. diameter fields we obtained no oozing epithelitis with 6,600 r.

The ratio of biological effectiveness of the same physical doses of the 23 mev. and of 200 kv. roentgen rays is in the neighborhood of 0.56 for different degrees of the skin erythema on rabbits: η (betatron 23 mev. @200 kv.//biol. resp: skin erythema, unit r)$\cong$0.56.

The *individual comparison* of effects on single animals considers the complete course of the reaction in all its phases: progression, peak, regression. The collective comparison considered the maximal

TABLE III

COLLECTIVE DATA OF PERMANENCE OF EPILATION

Dose in roentgens	No. of cases	No definite epilation		Threshold dose of epilation in 50% of cases	Temporary epilation		Permanent epilation		Dose of permanent epilation in 50% of cases
		No.	Per cent		No.	Per cent	No.	Per cent	
200 kv.									
800	10	7	70.0		3	30.0	—	—	
1,000	13	1	7.7		5	38.5	7	53.8	
1,200–1,300	21	1	4.8		2	9.5	18	85.7	
1,500–1,600	23	1	4.3		1	4.3	28	91.3	
1,800–2,000	13	—	—		—	—	13	100.0	
2,200–2,600	4	—	—		—	—	4	100.0	
2,700–3,500	6	—	—		—	—	6	100.0	
3,800–6,600		—	—		—	—			
				850 r					1,000 r
Betatron 23 mev.									
800	3	2	66.7		1	33.3	—	—	
1,000	9	6	66.7		3	33.3	—	—	
1,200–1,300	15	7	46.6		5	33.3	3	20.0	
1,500–1,600	18	8	44.4		2	11.1	8	44.4	
1,800–2,000	11	1	9.1		1	9.1	9	81.8	
2,200–2,600	14	—	—		—	—	14	100.0	
2,700–3,500	10	—	—		—	—	10	100.0	
3,800–6,600	10	—	—		—	—	10	100.0	
				1,200 r					1,600 r

η (betatron 23 mev. @200 kv.):
For threshold of epilation: 0.71
For permanent epilation: 0.62

intensity. The individual comparison can be facilitated by inspection, by superimposing comparable graphs, or by measuring on the graphs the area limited by lines representing progression, peak, regression, and base line. The area can be determined by a planimeter. The individual comparison of the efficiency resulted in an average ratio of 0.60, but our relating figures are less sufficient for the above mentioned reason. Therefore, the collective data are more reliable.

The *collective data of epilation* are shown in Table II. For a partial epilation in half of the cases 850 r was necessary with 200 kv., for complete epilation 1,000 r, for hyperepilation 1,150 r. The same doses for the betatron have been: 1,200, 1,550, and 1,750 r respectively. The ratio of efficiency was in the neighborhood of 0.71–0.65 for different degrees of the epilation, 0.67 for the standard, complete epilation: η (betatron 23 mev.@200 kv.//biol. resp: epilation, dosage unit r)$\cong$0.67.

From *individual comparisons* we obtained an average η of 0.65, but as mentioned above, our individual data are less adequate than the collective data.

If we compare the doses which were necessary for *temporary* and permanent epilation, we find these, as Table III shows, in 850 r and 1,000 r respectively for 200 kv., and in 1,200 r and 1,600 r respectively for the 23 mev. This means an η of approxi-

Table IV

LATITUDE OF DOSE PRODUCING THE SAME DEGREE OF REACTION

Reaction	200 kv.	Betatron 23 mev.
Suberythema	800– 900 r	1,200–1,600 r
Erythema	1,000–1,600 r	1,500–2,000 r
Hypererythema	1,300–over 4,000 r	1,800–over 6,600 r
Temporary epilation	800–1,200 r	1,000–1,600 r
Permanent epilation	from 1,200 r and over	from 1,200 r and over

mately 0.71 for the threshold and 0.62 for the permanent epilation. However, it must be noted that the possibility of exact observations was not as good in this respect as with the previous observations of the intensity of the epilation because of the different duration of survival of the rabbits. On the other hand, this observation relates rather to a consecutive postreaction condition dependent upon individual recovery possibilities than to the reaction itself.

The data show that there is a slight tendency to a lower ratio in the higher dose range, but the differences of the figures are not significant enough to permit a definite conclusion.

It is difficult to express quantitatively, but the observations give the impression that the reactions of proportional doses are generally milder with the betatron, the secondary atrophy being less marked.

The latitude of dose producing different degrees of the reactions is given in Table IV.

The latitude for the same degree of reactions was a little wider with the betatron than with 200 kv. roentgen rays. There is a latitude in dose necessary for a reaction not only in different animals but also on the same animal. Different doses can produce the seemingly identical alteration on the same animal. Figure 6 shows that the uppermost field is double because the rabbit moved during the irradiation. On account of it, both parts received about half of the given 2,500 r dose; on both fields the epilation and atrophy are similar to the middle field, where 2,000 r was delivered. The doubling of the dose does not mean that the effect will be doubled.

All these observations affirm the finding of Quastler and associates that one cannot establish one general coefficient for comparison of efficiency of different qualities of radiation. The ratio must be determined separately for different reactions and for different dose ranges. An established coefficient in efficiency of different irradiations is valid only for identical conditions. One finds occasionally also in clinical practice different radiosensitivity of the different components of the skin; erythema, epilation and pigmentation do not always go on in the same irradiated field.[3,7] The aforementioned equivalences in efficiency were found in rabbits and cannot be related without further investigations to the human skin. These *observations on patients* are in course.

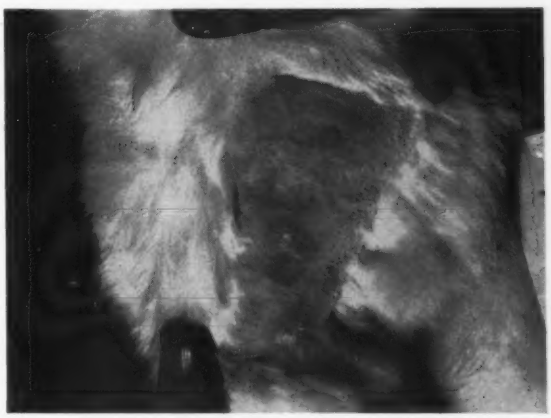

Fig. 6. The three epilated fields of the same rabbit with skin doses of 2,500, 1,600, 1,300 r with 200 kv. after three months. The uppermost field is double due to motion during the irradiation. In spite of the consequently diminished dose, there is permanent epilation on both parts (see text).

Theoretically the entering surface dose from the betatron roentgen-ray beam can be neglected in the human irradiations, especially when experiment shows it to be less than 8 per cent of the maximum dose.[11] Practically it cannot be dismissed. The reaction depends not on the reaction in the superficial epidermis layers but on the reaction in capillary layers and hair follicles. Their depths are stated[10,19] as averaging 2.1 mm. and 2.6 mm. respectively. At these depths the betatron dose is rising rapidly and ranges from 20 to 30 per cent, depending on field size and on topical variations. One millimeter difference in depth means a significant difference in absorption with this beam shortly after its entrance into tissue. The regional determination of the depth of the deep capillary layer and hair follicles is in course of study.

The determination of dose on the exit surface is easier with physical methods. In our medical irradiations no epilation and no erythema was found on the entrance surface with 1,000 r single maximal dose of the 23 mev. (calculated to conform to about 300 r in level of the hair follicles of the skin). On the other hand, with 600 r maximal dose we observed in one case moderate epilation on the exit surface of the head (calculated for 450 r at the exit level of the skin), without erythema.

The ratio of efficiency around 60 per cent obtained in this study conforms to our observations of skin erythema, epilation, and mucous membrane reactions in tumor areas of patients. The tumor dose also seems to follow this 60 per cent ratio.

Our experiences show that a tumor dose of about 10,000 r in four and one-half to five and one-half weeks from the 23 mev. betatron gives equivalent effects to 6,000 r in the same time from the 200 kv. roentgen-ray machines. The quantitative difference in biological effectiveness, of course, does not in any way influence the advantages and usefulness of the betatron.

SUMMARY

1. The efficiency (η) of the 23 mev. betatron roentgen-ray irradiation compared with 200 kv. was found as approximately 0.56 for the erythema of the rabbit skin.

2. The same efficiency was 0.67 for epilation of the rabbit skin.

3. The ratio of efficiency must be determined separately for different reactions.

4. This ratio is approximately 0.60 for the tumor dose of human patients.

The authors wish to express their appreciation to Henry Quastler, M.D., for reviewing the data and offering valuable suggestions for its presentation.

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THE AMERICAN JOURNAL OF ROENTGENOLOGY, RADIUM THERAPY AND NUCLEAR MEDICINE

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Published by: CHARLES C THOMAS, PUBLISHER, 301–327 East Lawrence Avenue, Springfield, Illinois.

Issued monthly. Annual subscription: United States, Mexico, Cuba, Central and South America, $15.00; Canada, $16.00; other countries, $17.00. Current single numbers, $1.50. Advertising rates submitted on application. Editorial office, 110 Professional Building, Detroit 1, Michigan. Office of publication, 301–327 East Lawrence Avenue, Springfield, Illinois. Information of interest to authors and readers will be found on page iv.

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Thirty-fifth Annual Meeting: Plaza Hotel, St. Louis, Mo., April 19, 20, 21 and 22, 1953.

EDITORIAL

PNEUMOPERITONEUM AND PNEUMO-RETROPERITONEUM

FIFTY years ago Kelling[1] inflated for the first time the peritoneal cavity with air, which had been filtered by passage through cotton, to obtain a better view of the abdominal organs in performing endoscopic examination. Ten years later, Weber[2] conceived the idea that such intraperitoneal inflation with air or oxygen might advantageously be combined with roentgenologic procedures, enabling visualization of viscera which could not be demonstrated on the ordinary roentgenograms. Following various clinical trials, especially by European investigators, the method, which eventually became known under the name of pneumoperitoneum, was introduced into the United States in 1919 by Stewart and A. Stein,[3] who first applied it in a case of gunshot wound of the chest in an attempt to determine whether the bullet was located in the lower lobe of the lung, embedded in the diaphragm, or had passed through the diaphragm into the liver.

In 1921, A. Stein and Stewart[4] published a very comprehensive monograph on the subject, with an atlas of beautifully reproduced roentgenographic plates, amply illustrating the possibilities as they suggested themselves at that time. Stein and Stewart found the new method greatly superior to all others for the recognition of intra-abdominal adhesions and of early peritoneal tuberculosis and for demonstrating the extent of these lesions. The method was also shown to be of considerable value in the following situations: the diagnosis of diseases of the liver, gallbladder and bile ducts; the demonstration of the presence or absence of subdiaphragmatic tumors, abscesses and adhesions; the visualization of the kidney regions and the various processes located thereabout, especially in differentiating between tumors and enlargements of the kidney and spleen, on the one side, and those of the kidney and liver on the other; the localization of projectiles in and around the diaphragm; and the diagnosis of various pelvic conditions and some extraperitoneal tumors.

These precise indications of diagnostic pneumoperitoneum were soon endorsed by numerous other investigators who in the early 1920s employed the method on an increasingly larger scale. The technique of injection was refined and greatly simplified and, following the introduction in 1921 by Alvarez[5] of the rapidly absorbing carbon dioxide as the gas for injection, the procedure was considered to be ready for general use. The only contraindications suggested were cardiovascular diseases, acute infections and advanced age.

Yet a review of the situation three decades later shows that, despite the very promising early contributions, pneumoperitoneum, either in the form of transabdominal or transuterine insufflation, failed to become a routine method of diagnostic investigation. In many large centers

[1] Kelling, G. Ueber Oesophagoskopie, Gastroskopie und Coeloskopie. *München. med. Wchnschr.*, 1902, *49*, 21–24.

[2] Weber, E. Ueber die Bedeutung der Einführung von Sauerstoff resp. Luft in die Bauchhöhle für die experimentelle und diagnostische Röntgenologie. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1913, *20*, 453–455.

[3] Stewart, W. H., and Stein, A. Roentgen-ray study of the abdominal organs following oxygen inflation of the peritoneal cavity. AM. J. ROENTGENOL., 1919, *6*, 533–542.

[4] Stein, Arthur, and Stewart, William H. Pneumo-peritoneal Roentgen Ray Diagnosis. A Monograph with Atlas. The Southworth Company, Troy, N. Y., 1921, 79 pages with 34 plates.

[5] Alvarez, Walter C. The use of CO_2 in pneumoperitoneum. AM. J. ROENTGENOL., 1921, *8*, 71–72.

it has been abandoned altogether; in others, its use has been restricted to the study of a few pelvic and occasional abdominal lesions in which all other means of examination have been exhausted.

This lack of popularity of diagnostic pneumoperitoneum is difficult to explain. Only a few cases of untoward reactions incident to the method are described in the literature, although it must be admitted that the number of large series of studies published is not sufficient to permit entirely satisfactory conclusions.

Perhaps a better understanding of the problem can be gained by analyzing the complications which ordinarily follow therapeutic pneumoperitoneum—a method which for the past two decades has found extensive use mainly in the treatment of pulmonary tuberculosis. H. F. Stein,[6] after a thorough perusal of the literature, has recently compiled a very complete list of these complications. He found that, contrary to the general belief, pneumoperitoneum may be associated with more than forty different complications and that 5 to 6 per cent of all patients who are subjected to the procedure for therapeutic purposes will develop complications serious enough to make discontinuation of the treatment necessary.

The gravest complication on H. F. Stein's list is immediate or delayed death which occurred in one case following intra-abdominal hemorrhage, in two cases following the development of spontaneous pneumothorax and in fifteen cases as a result of air embolism. The other more important complications are classified as follows: *cardiac and pulmonary complications:* dyspnea, cardiac decompensation in older persons, and in those with an already damaged heart, pulmonary atelectasis, accidental and spontaneous pneumothorax; *gastrointestinal and abdominal complications:* nausea and vomiting, hiccough, melena, rectal hemorrhage, peritonitis, peritoneal effusion, adhesions, intra-abdominal hemorrhage, puncture of viscera, hemorrhage into spleen and torsion of the spleen or omentum; *complications of abdominal wall:* subumbilical hematoma, umbilical pneumocele, hernia and scrotal pneumocele. Among the minor complications enumerated are pain, anorexia, fever, vertigo, and various forms of interstitial emphysema which generally are of little clinical significance.

In evaluating these complications in their true perspective, account must be taken of the fact that therapeutic pneumoperitoneum is established and re-established, as a rule with air inflation, at frequent intervals extending over a long period of time. Diagnostic pneumoperitoneum, on the other hand, is usually performed once, using the rapidly absorbable carbon dioxide for inflation. The implication is, therefore, considerable that the latter form of use would be technically less hazardous, lending support to the repeated assertions found in the literature that "diagnostic pneumoperitoneum, if properly executed, is a relatively harmless procedure." It is then more probable that the main reason for the failure of the method to become popular is the hesitancy to subject patients even to such minor untoward effects as pain, nausea and vertigo which invariably follow the examination. The discomfort produced is considered by many to be too great to justify routine employment of an accessory diagnostic investigation for the corroboration of findings which could be ascertained, though sometimes less precisely, by other clinical means. It may be of interest, in this respect, to cite here the statement of Alvarez[5] who in 1921 prognosticated that "pneumoperitoneum would never come into general use unless some way were found of relieving the patient's discomfort immediately after the roentgen exposures were made."

Realizing the disadvantages of pneumoperitoneum, several investigators tried to produce contrast for roentgen visualization by rendering the tissues emphysematous with the aid of oxygen injected in the area

[6] Stein, Hans F. Complications of artificial pneumoperitoneum; a review. *Am. Rev. Tuberc.*, Dec., 1951, *64*, 645–658.

surrounding the particular organ to be examined. Foremost among these procedures was perirenal insufflation which was proposed by Carelli,[7] and independently by Rosenstein,[8] in 1921. Others followed. However, these methods also failed to gain general applicability owing to the not infrequent fatal accidents, due mainly to air embolism, which were reported in several instances.

In 1948 Ruiz Rivas[9] introduced generalized retroperitoneal emphysema for contrast study, now bearing the name of pneumoretroperitoneum. This author injected by a single puncture oxygen into the precoccygeal areolar tissue, whence the gas diffused upward, forming a subserous emphysema which aids in differentiating roentgenologically the organs which it surrounds.

In a later publication[10] Ruiz Rivas demonstrated that there is an anatomical continuity of the deep areolar tissue throughout the body and that institution of emphysema at certain levels leads to diffusion of the gas into wide areas of the adjacent cellular tissues or even throughout large sections of the body. He has chosen the precoccygeal areolar tissue for the injection of the gas because of its accessibility and its ample communication with the pelvic and retroperitoneal tissues. Moreover, the diffusion may extend through the weak points of the diaphragm to the tissues of the mediastinum and neck. As the gas slowly diffuses upward through each succeeding compartment, the resulting emphysema may be called pneumoparametrium, pneumoretroperitoneum, pneumomediastinum, and so forth, depending on which compartment constitutes the object of the particular study.

Pneumoretroperitoneum, which usually includes pneumoparametrium, is, according to Ruiz Rivas, of great value in demonstrating roentgenologically all of the pelvic and most of the solid abdominal organs. Thus, good visualization is obtained of the uterus, fallopian tubes, ovaries, kidneys, adrenals, liver, spleen, the leaves of the diaphragm, the psoas muscles, cul-de-sacs of the peritoneum, the retroperitoneally situated part of the intestine and, of course, of the space occupying pathologic processes associated with any of these organs. Among its advantages over other pneumographic methods are that only one puncture is required, that the possibility of air embolism is eliminated and that, due to better anatomical distribution of the gas, a more satisfactory topographic visualization of the various organs is obtained.

Pneumoretroperitoneum, as conceived by Ruiz Rivas, has recently been employed by a number of investigators. Excellent articles have been published by Juri,[11] de Gennes, May, Simon and Benzecry,[12] Scarinci,[13] Mosca,[14] Baena and Mattoso Filho,[15] Steinbach, Lyon, Miller and Smith,[16] Fager-

[7] Carelli, H. H. Sur le pneumopéritoine et sur une méthode personnelle pour voir le rein sans pneumopéritoine. *Bull. et mém. Soc. méd. d. hôp. de Paris*, 1921, *45*, 1409–1412; also, *Rev. Asoc. méd. argent.*, 1921, *34*, 421–424; 424–427.

[8] Rosenstein, P. Die "Pneumoradiographie des Nierenlagers," ein neues Verfahren zur radiographischen Darstellung der Nieren und ihrer Nachbarorgane (Nebenniere, Milz, Leber). *Ztschr. f. Urol.*, 1921, *15*, 447–458.

[9] Ruiz Rivas, M. Diagnóstico radiológico. El neumorriñon. *Arch. españ. urol.*, 1948, *4*, 228–233.

[10] Ruiz Rivas, M. Roentgenological diagnosis; generalized subserous emphysema through a single puncture. Am. J. Roentgenol. & Rad. Therapy, Nov., 1950, *64*, 723–734.

[11] Juri, A. Neumo-para-riñon; uso de una nueva vía. *Prensa méd. argent.*, 1949, *36*, 1733–1736.

[12] de Gennes, L., May, J.-P., and Simon, G. Le rétropneumopéritoine (nouveau procédé d'exploration radiologique de l'abdomen). *Presse méd.*, April 5, 1950, *58*, 351–352. (Abstr. this Journal, March, 1951, *65*, 510–511); also de Gennes, L., May, J.-P., Simon, G., and Benzecry, I. Sobre el retroneumoperitoneo; un nuevo procedimiento de exploración radiológica del abdomen. *Prensa méd. argent.*, Jan. 26, 1951, *38*, 171–175. (Abstr. this Journal, Nov., 1951, *66*, 865).

[13] Scarinci, Carmelo. Il retropneumoperitoneo. (Nuova metodologia di contrasto degli organi addominali.) *Radiol. med.*, Aug., 1950, *36*, 660–664. (Abstr. this Journal, Aug., 1951, *66*, 296–297).

[14] Mosca, Lidio G. Das retroperitoneale Emphysem (r E), eine neue Aufnahmetechnik. *Röntgen-Blätter*, Jan., 1951, *4*, 1–11. (Abstr. this Journal, Nov., 1951, *66*, 864–865); also Mosca, Lidio G. El enfisema retroperitoneal: su técnica, sus indicaciones y resultados. *Arch. españ. urol.*, Jan., 1951, *7*, 1–23; also, *Prensa méd. argent.*, April 27, 1951, *38*, 1025–1035. (Abstr. this Journal, Jan., 1952, *67*, 162.)

[15] Baena, Figueiredo, and Mattoso Filho, J. Diagnóstico radiológico em urologia. (A proposito do enfisema retro-peritoneal.) *Rev. brasil. de cir.*, May, 1951, *21*, 371–392. (Abstr. this Journal, June, 1952, *67*, 1017–1018.)

[16] Steinbach, Howard L., Lyon, Richards P., Miller, Earl R., and Smith, Donald R. Extraperitoneal pneumography; a preliminary report. *California Med.*, July, 1951, *75*, 202–206; also, Steinbach, Howard L., Lyon, Richards P., Smith, Donald R., and Miller, Earl R. Extraperitoneal pneumography. *Radiology*, Aug., 1952, *59*, 167–176.

berg,[17] Sommer and Reinhardt,[18] Buetti-Bäuml,[19] Gershon-Cohen, Levine and Hermel,[20] and others. A statistical compilation of all examinations recorded in these articles shows that the method has been used in more than five hundred cases. The pathologic lesions which have been successfully demonstrated include renal tumors and cysts, hydronephrosis, perinephric abscess, tumors involving the inferior portion of the liver, retroperitoneal tumors and cysts, hepatosplenomegaly, and various pelvic lesions. It is claimed that the adrenals are better visualized than with any other procedure. All authors agree that no serious untoward reactions or incidents are observed. The only possible complications are incidental puncture of the rectum, extension of the emphysema into the mediastinum and neck, producing transient dysphagia and voice changes, and subcutaneous emphysema of the perineum when the needle has not been inserted far enough.

All in all, it appears that pneumoretroperitoneum combines all the advantages of pneumoperitoneum and perirenal insufflation without their disadvantages. The method, however, like the other procedures, is not entirely free of discomfort. At the beginning of the injection, the patient has slight pain in the left iliac fossa, changing to a more pronounced lumbalgia as the gas diffuses upward. This is usually relieved after half an hour, although some patients will complain of pain along the right phrenic nerve, especially in the erect position, for twenty-four hours. When the emphysema has extended as far as the mediastinum and neck, it may require six to seven days for its complete absorption. Only the passage of time will determine whether the discomfort produced by these apparently insignificant complications will have the same restricting influence on the popularization of this new method as it had in the case of pneumoperitoneum.

T. Leucutia, M.D.

[17] Fagerberg, Stig. Pneumoretroperitoneum; technique and results. *Acta radiol.*, June, 1952, *37*, 519–530.

[18] Sommer, F., and Reinhardt, K. Das diagnostische subseröse Emphysem. *Fortschr. a. d. Geb. d. Röntgenstrahlen ver. m. Röntgenpraxis*, July, 1952, *77*, 54–62.

[19] Buetti-Bäuml, C. Über eine neue Technik in der Röntgendiagnostik: Das Pneumoretroperitoneum. *Radiol. clin.*, July, 1952, *21*, 225–242.

[20] Gershon-Cohen, J., Levine, Samuel, and Hermel, M. B. Retroperitoneal pneumography by injection of oxygen into the presacral space. Am. J. Roentgenol., Rad. Therapy & Nuclear Med., Sept., 1952, *68*, 391–394.

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

MEETINGS OF ROENTGEN SOCIETIES*

United States of America

American Roentgen Ray Society
Secretary, Dr. Barton R. Young, Germantown Hospital, Philadelphia 44, Pa. Annual meeting: 1953, to be announced.

American Radium Society
Secretary, Dr. J. E. Wirth, 635 Herkimer St., Pasadena 1, Calif. Annual meeting: Plaza Hotel, St. Louis, Mo., April 19–22, 1953.

Radiological Society of North America
Secretary, Dr. D. S. Childs, 713 E. Genesee St., Syracuse 2, N. Y. Annual meeting: Netherland-Plaza Hotel, Cincinnati, Ohio, December 7 to 12, 1952.

American College of Radiology
Executive Secretary, William C. Stronach, 20 N. Wacker Drive, Chicago 6, Illinois.

Section on Radiology, American Medical Association
Secretary, Dr. T. Leucutia, Harper Hospital, Detroit 1, Mich. Annual meeting: 1953, to be announced.

Alabama Radiological Society
Secretary, Dr. J. A. Meadows, Jr., Medical Arts Bldg., Birmingham 5, Ala. Meets time and place Alabama State Medical Association.

Arizona Radiological Society
Secretary, Dr. R. Lee Foster, 15 E. Monroe, Phoenix, Ariz. Two regular meetings a year. The annual meeting at time and place of State Medical Association and interim meeting six months later.

Arkansas Radiological Society
Secretary, Dr. Fred Hames, 511 National Bldg., Pine Bluff, Ark. Meets every three months and also at time and place of State Medical Association.

Atlanta Radiological Society
Secretary, Dr. Albert A. Rayle, Jr., 478 Peachtree St., N.E., Atlanta, Ga. Meets monthly, except during three summer months, on second Friday evening.

Brooklyn Roentgen Ray Society
Secretary, Dr. J. J. Daversa, 345 75th St., Brooklyn, N. Y. Meets monthly fourth Tuesday, October through April.

Buffalo Radiological Society
Secretary, Dr. Mario C. Gian, 610 Niagara St., Buffalo, N. Y. Meets second Monday evening each month, October to May inclusive.

Central New York Roentgen Ray Society
Secretary, Dr. Dwight V. Needham, 608 E. Genesee St., Syracuse N. Y. Meets January, May, November.

Central Ohio Radiological Society
Secretary, Dr. F. A. Riebel, 15 West Goodale St., Columbus, Ohio. Meets at 6:30 P.M. on second Thursday of October, December, February, April, and June at Columbus Athletic Club, Columbus, Ohio.

Chicago Roentgen Society
Secretary, Dr. Elbert K. Lewis, 6337 S. Harvard Ave., Chicago, Ill. Meets second Thursday of each month, October to April inclusive at the University Club.

Cleveland Radiological Society
Secretary, Dr. Mortimer Lubert, 10515 Carnegie Ave., Cleveland 6, Ohio. Meetings at 6:45 P.M. on fourth Monday of each month from October to April.

Colorado Radiological Society
Secretary, Dr. W. P. Stampfli, 1933 Pearl St., Denver, Colo. Meets third Friday of each month at University of Colorado Medical Center or at Denver Athletic Club.

Connecticut Valley Radiologic Society
Secretary, Dr. E. W. Godfrey, 1676 Boulevard, West Hartford, Conn. Meets second Friday October and April.

Dallas-Fort Worth Roentgen Study Club
Secretary, Dr. X. R. Hyde, Medical Arts Bldg., Fort Worth, Texas. Meets in Dallas on odd months and in Fort Worth on even months, on third Monday, 7:30 P.M.

Detroit Roentgen Ray and Radium Society
Secretary, Dr. J. C. Cook, Harper Hospital, Detroit, Mich. Meets monthly first Thursday, October to May, at Wayne County Medical Society Building.

East Bay Roentgen Society
Secretary, Dr. Dan Tucker, 434 30th St., Oakland 9, Calif. Meets first Thursday each month at Peralta Hospital, Oakland.

Florida Radiological Society
Secretary, Dr. A. Judson Graves, 2002 Park St., Jacksonville, Fla. Meets twice annually, in the spring with the annual State Society meeting, and in the fall.

Georgia Radiological Society
Secretary, Dr. Robert M. Tankesley, 218 Doctors Bldg., Atlanta, Ga. Meets in mid-winter and at annual meeting of Medical Association of Georgia in the spring.

Greater Miami Radiological Society
Secretary, Dr. Maurice Greenfield, Ingraham Bldg., Miami, Fla. Meets third Wednesday of each month at Veterans Administration Building.

Houston Radiological Society
Secretary, Dr. F. M. Windrow, 1205 Hermann Professional Bldg., Houston, Texas. Meets fourth Monday each month.

Idaho State Radiological Society
Secretary, Dr. Alfred M. Stone, St. Lukes Hospital, Boise, Idaho. Meets annually at same time as Idaho State Medical Association.

Illinois Radiological Society
Secretary, Dr. Stephen L. Casper, 1101 Maine St., Quincy, Ill. Meets three times a year.

Indiana Roentgen Society
Secretary, Dr. William M. Loehr, 712 Hume-Mansur Bldg., Indianapolis 4. Meets second Sunday in May.

Iowa X-Ray Club
Secretary, Dr. James McMillan, 1104 Bankers Trust Bldg., Des Moines, Iowa. Luncheon and business meeting during annual session of Iowa State Medical Society. The scientific section is held in the autumn.

Kansas Radiological Society
Secretary, Dr. Willis L. Beeler, M.D., 700 Kansas Ave., Topeka, Kansas. Meets in spring with State Medical Society, and in winter on call.

Kentucky Radiological Society
Secretary, Dr. E. L. Pirkey, Louisville General Hospital, Louisville 2, Ky. Meets monthly on second Friday at Seelbach Hotel, Louisville.

Kings County Radiological Society
Secretary, Dr. Marcus Wiener, 1430 48th St., Brooklyn, N. Y. Meets Kings County Med. Soc. Bldg. monthly on fourth Thursday, October to May, 8:45 P.M.

Los Angeles Radiological Society
Secretary, Dr. John B. Hamilton, 210 N. Central Ave., Glendale 3, Calif. Meets second Wednesday each month at Los Angeles County Medical Association Building.

Louisiana Radiological Society
Secretary, Dr. J. R. Anderson, 1130 Louisiana Ave., Shreveport. Meets annually during Louisiana State Medical Society Meeting.

Maine Radiological Society
Secretary, Dr. C. F. Miller, Central Maine General Hospital, Lewiston, Maine.

* Secretaries of societies are requested to send timely information promptly to the Editor.

Miami Valley Radiological Society
Secretary, Dr. G. A. Nicoll, 134 Apple St., Dayton, Ohio. Meets second Friday of fall and winter months.

Mid-Hudson Radiological Society
Secretary, Dr. J. W. Walton, Horton Memorial Hospital, Middletown, N. Y. Meets 8:30 P.M., fourth Tuesday each month, September to May.

Milwaukee Roentgen Ray Society
Secretary, Dr. T. J. Pfeffer, 839 N. Marshall St., Milwaukee 2, Wis. Meets monthly on second Monday at University Club.

Minnesota Radiological Society
Secretary, Dr. L. A. Nash, 572 Lowry Medical Arts Bldg., St. Paul 2, Minn. Meets three times annually, once at time of State Med. Assn., and in spring and fall.

Mississippi Radiological Society
Secretary, Dr. John W. Evans, 621 High Street, Jackson 2, Miss. Meets third Thursday of each month at the Rotisserie Restaurant at 6:30 P.M.

Nassau Radiological Society
Secretary, Dr. Joseph J. La Vine, 259 North Grand Ave., Baldwin, N. Y. Meets second Tuesday of the month in February, April, June, October and December.

Nebraska Radiological Society
Secretary, Dr. R. W. Blanchard, 1216 Medical Arts Bldg., Omaha, Nebr. Meets fourth Thursday of each month at 6 P.M. at Omaha or Lincoln.

New England Roentgen Ray Society
Secretary, Dr. Stanley M. Wyman, Massachusetts General Hospital, Boston, Mass. Meets monthly on third Friday, Harvard Club.

New Hampshire Roentgen Ray Society
Secretary, Dr. A. C. Johnston, Elliott Community Hospital, Keene, N. H. Meets four to six times yearly.

New York Roentgen Society
Secretary, Dr. Harold W. Jacox, 622 W. 168th St., New York 32, N. Y. Meets monthly on third Monday, New York Academy of Medicine, at 8:30 P.M.

North Carolina Radiological Society
Secretary, Dr. J. E. Hemphill, 1420 E. Fifth St., Charlotte 4, N. C. Meets in May and October.

North Dakota Radiological Society
Secretary, Dr. C. O. Heilman, 807 Broadway, Fargo. Meetings by announcement.

Northeastern New York Radiological Society
Secretary, Dr. John F. Roach, Albany Hospital, Albany, N. Y. Meets on the second Wednesday of October, November and March at the University Club, Albany. Annual meeting in June to be announced.

Northern California Radiological Club
Secretary, Dr. G. A. Fricker, Sacramento County Hospital, Sacramento, Calif. Meets at dinner last Monday, every second month, except June, July and August.

Ohio State Radiological Society
Secretary, Dr. Willis S. Peck, 2001 Collingwood Blvd., Toledo, Ohio.

Oklahoma State Radiological Society
Secretary, Dr. John R. Danstrom, Medical Arts Bldg., Oklahoma City, Okla. Three regular meetings annually.

Oregon Radiological Society
Secretary, Dr. J. Richard Raines, 214 Medical-Dental Bldg., Portland 5, Oregon. Meets monthly from October to June on the second Wednesday of each month at 8:00 P.M. at the University Club.

Orleans Parish Radiological Society
Secretary, Dr. Joseph V. Schlosser, Charity Hospital, New Orleans 13, La. Meets first Tuesday of each month.

Pacific Northwest Radiological Society
Secretary, Dr. S. J. Hawley, 1320 Madison St., Seattle 4, Wash. Meets annually in May.

Pacific Roentgen Society
Secretary, Dr. L. H. Garland, 450 Sutter St., San Francisco, Calif. Meets annually, during meeting of California Medical Association.

Pennsylvania Radiological Society
Secretary, Dr. J. M. Converse, 416 Pine St., Williamsport.

Philadelphia Roentgen Ray Society
Secretary, Dr. George P. Keefer, American Oncologic Hospital, Philadelphia 4, Pa. Meets first Thursday of each month, at 5 P.M., from October to May in Thompson Hall, College of Physicians.

Pittsburgh Roentgen Society
Secretary, Dr. Donald H. Rice, Western Pennsylvania Hospital, Pittsburgh 24, Pa. Meets 6:00 P.M. at Webster Hall Hotel on second Wednesday each month, October to May inclusive.

Radiological Section, Baltimore Medical Society
Secretary, Dr. H. Leonard Warres, 2337 Eutaw Place, Baltimore 17, Md. Meets third Tuesday each month, September to May, inclusive.

Radiological Section, Connecticut Medical Society
Secretary, Dr. William A. Goodrich, 85 Jefferson St., Hartford 6, Conn. Meetings are held bi-monthly.

Radiological Section, Medical Society of the District of Columbia
Secretary, Dr. U. V. Wilcox, 915 Nineteenth St., N. W., Washington 6, D. C. Meets Medical Society Library, third Thursday of January, March, May and October at 8:00 P.M.

Radiological Section, Southern Medical Association
Secretary, Dr Roy G. Giles, Temple, Texas.

Radiological Society of Greater Cincinnati
Secretary, Dr. Harry K. Hines, 2508 Auburn Ave., Cincinnati 19, Ohio. Meets monthly from September to June on first Monday of each month at 7:30 P.M. at the Cincinnati General Hospital.

Radiological Society of Hawaii
Secretary, Colonel Alexander O. Haff, M.C., Tripler Army Hospital, Honolulu, T. H. Meets third Friday of each month at Tripler Army Hospital.

Radiological Society of Kansas City
Secretary, Dr. Arthur B. Smith, 800 Argyle Bldg., Kansas City, Mo. Meets third Thursday of each month.

Radiological Society of New Jersey
Secretary, Dr. Nicholas G. Demy, 912 Prospect Avenue, Plainfield, N. J. Meets annually at Atlantic City at time of State Medical Society and mid-winter at Elizabeth, N. J.

Richmond County Radiological Society
Secretary, Dr. W. F. Hamilton, Jr., University Hospital, Augusta, Ga.

Rochester Roentgen Ray Society, Rochester, N. Y.
Secretary, Dr. Robert J. Bloor, 260 Crittenden Blvd., Rochester, N. Y. Meets last Monday of each month, September through May, at Strong Memorial Hospital.

Rocky Mountain Radiological Society
Secretary, Dr. Maurice D. Frazer, 1037 Stuart Bldg., Lincoln, Nebr. Next annual meeting, Shirley-Savoy Hotel, Denver, Colo., August 20, 21 and 22, 1953.

St. Louis Society of Radiologists
Secretary, Dr. Francis O. Trotter, Jr., 634 N. Grand Blvd., St. Louis 3, Mo. Meets fourth Wednesday each month, except June, July, August and September.

San Antonio-Military Radiological Society
Secretary, Dr. Hugo F. Elmendorf, Jr., 730 Medical Arts Bldg., San Antonio 5, Texas. Meets Brook Army Medical Center Officers Mess first Monday of each month.

San Diego Radiological Society
Secretary, Dr. Rex Uncapher, 7720 Girard Ave., La Jolla, Calif. Meets first Wednesday of each month at the University Club.

San Francisco Radiological Society
Secretary, Dr. I. J. Miller, 2680 Ocean Avenue, San Francisco 27, Calif. Meets quarterly.

Section on Radiology, California Medical Association
Secretary, Dr. Calvin L. Stewart, 2330 First Ave., San Diego 1, Calif.

Section on Radiology, Illinois State Medical Society
Secretary, Dr. Harold L. Shinall, St. Joseph's Hospital, Bloomington, Ill.

Shreveport Radiological Club
Secretary, Dr. R. W. Cooper, Charity Hospital, Shreveport, La. Meets monthly on third Wednesday, at 7:30 P.M., September to May inclusive.

South Bay Radiological Society
Secretary, Dr. Ford Shepherd, 526 Soquel Avenue, Santa Cruz, Calif. Meets second Wednesday each month.

South Carolina Radiological Society
Secretary, Dr. Henry E. Plenge, Spartanburg General Hospital, Spartanburg, S. C. One meeting with South Carolina Medical Association in May, others arranged by President.

Tennessee Radiological Society
Secretary, Dr. J. M. Frère, Newell Hospital, Chattanooga, Tenn. Meets annually at the time and place of the Tennessee State Medical Association.

Texas Radiological Society
Secretary, Dr. R. P. O'Bannon, 650 Fifth Ave., Fort Worth 4, Texas. Next meeting: San Antonio, Texas, January 23 and 24, 1953.

University of Michigan Department of Roentgenology Staff Meeting
Meets each Monday evening from September to June, at 7:00 P.M. at University Hospital.

University of Wisconsin Radiological Conference
Secretary, Dr. E. A. Pohle, 1300 University Ave., Madison, Wis. Meets first and third Thursdays 4:00 to 5:00 P.M., September to May, Service Memorial Institute.

Utah State Radiological Society
Secretary, Dr. Angus K. Wilson, 343 S. Main St., Salt Lake City 1, Utah. Meets third Wednesday in September, November, January, March and May.

Virginia Radiological Society
Secretary, Dr. P. B. Parsons, Norfolk General Hospital, Norfolk, Va. Meets annually in October.

Washington State Radiological Society
Secretary, Dr. John N. Burkey, 555 Medical-Dental Bldg., Seattle 1, Wash. Meets fourth Monday of each month from September through May.

Westchester Radiological Society
Secretary, Dr. Walter J. Brown, Northern Westchester Hospital, Mt. Kisco, N. Y. Meets on third Tuesdays of January and October and on two other dates.

Wisconsin Radiological Society
Secretary, Dr. Irving I. Cowan, 425 E. Wisconsin Ave., Milwaukee 2, Wis. Special meetings held during year; annual meeting each spring at Madison, Wis.

X-Ray Study Club of San Francisco
Secretary, Dr. Charles E. Duisenberg, Palo Alto Clinic, 300 Homer Ave., Palo Alto, Calif. Meets third Thursday at 7:45 P.M., January to June, Lane Hall, Stanford University Hospital; July to December, San Francisco Hospital.

Cuba, Mexico and Central America

Sociedad de Radiología y Fisioterapia de Cuba
President, Dr. J. Manuel Viamonte, Hospital Mercedes, Habana, Cuba. Meets monthly in Habana.

Sociedad Mexicana de Radiologia y Fisioterapia
General Secretary, Dr. D. P. Cossio, Marsella No. 11, Mexico, D. F. Meets first Monday of each month.

Sociedad Radiológica Panameña
Secretary, Dr. L. Arrieta Sanchez, Apartado No. 86, Panama, R. de P. Meets monthly in a department of radiology of a local hospital, chosen at preceding meeting.

British Empire

British Institute of Radiology Incorporated with the Röntgen Society
Ordinary meeting, on the Thursday preceding the third Friday, October to May at 8:15 P.M.
Medical Members' meeting, on third Friday in each month at 5:00 P.M., 32 Welbeck St., London, W 1. Annual Meeting, London, England, December 4 and 5, 1952.

Faculty of Radiologists
Honorary Secretary, Dr. J. F. Bromley, 45, Lincoln's Inn Fields, London, W.C.2, England.

Section of Radiology of the Royal Society of Medicine (Confined to Medical Members)
Meets third Friday each month at 4:45 P.M. at the Royal Society of Medicine, 1 Wimpole St., London.

Canadian Association of Radiologists
Honorary Secretary-Treasurer, Dr. Jean Bouchard, Suite 305, 1555 Summerhill Avenue, Montreal 26, Que. Meetings January and June.

Section of Radiology, Canadian Medical Association
Secretary, Dr. C. M. Jones, Inglis St., Ext. Halifax, N. S.

Société Canadienne-Française d'Electrologie et de Radiologie Médicales
Secretary, Dr. Origéne Dufresne, 4120 Ontario St., East, Montreal, P. Q.

Australian and New Zealand Association of Radiologists
Honorary Secretary, Dr. Alan R. Colwell, 135 Macquarie St., Sydney, N.S.W.
Honorary Secretaries, State Branches:
New South Wales, Dr. E. W. Frecker, 135 Macquarie St., Sydney.
Victoria, Dr. T. L. Tyrer, 3 Lockerbie Court, East St. Kilda.
Queensland, Dr. J. Adam, 131 Wickham Terrace, Brisbane.
South Australia, Dr. R. deG. Burnard, 170 North Terrace, Adelaide.
Western Australia, Dr. A. M. Nelson, 179 B St. Georges Terrace, Perth.
New Zealand, Dr. E. G. Lynch, 12 Bolton St., Wellington.

South America

Asociacion Argentina de Radiologia
Secretary, Dr. Lidio G. Mocsa, Avda. Gral Paz 151, Córdoba, Argentina. Meetings held monthly.

Sociedad Argentina de Radiologia, Junta Central, Buenos Aires
Secretary, Dr. Oscar F. Noguera, Santa Fe 1171, Buenos Aires. Meetings are held monthly.

Sociedad Argentina de Radiologia, Filial del Litoral, Sede, Rosario
President, Dr. Francisco P. Cifarelli. Meets monthly second Wednesday, 19 ha 663 Italia St., Rosario, Santa Fe.

Sociedad Argentina de Radiologia, Filial del Sur, Sede, La Plata
President, Prof. Dr. Jose P. Uslenghi, La Plata. Meets monthly.

Sociedad Argentina de Radiologia, Filial del Centro, Sede, Cordoba
President, Prof. Dr. David L. Caro, Corro 86, Cordoba. Meets monthly.

Sociedad Argentina de Radiologia, Filial del Norte, Sede, Tucuman
President, Dr. Julio Mendez Valladares, Rivadavia 358, Tucuman. Meets monthly.

Sociedad Argentina de Radiologia, Filial de Cuyo Sede, Mendoza.
President, Dr. J. A. Orfila, Hospital Central, Mendoza. Meets monthly.

Sociedade Brasileira de Radiologia Medica
Secretary, Dr. Nicola Caminha, Av. Mem de Sa, Rio de Janeiro, Brazil. Meets monthly, except during January, February and March.

Sociedade Brasileira de Radioterapia
Secretary, Dr. Oscar Rocha von Pfuhl, Av. Brigadeiro Luiz Antonio, 644 São Paulo, Brazil. Meets monthly on second Wednesday at 9:00 P.M. in São Paulo at Av. Brigadeiro Luiz Antonio, 644.

Sociedad Colombiana de Radiologia
Secretary, Dr. Alberto Torres Focke, Av. 34, No. 17-34, Bogota, Colombia. Meets last Wednesday of each month.

Sociedad Peruana de Radiologia
Secretary, Dr. Julio Bedoya Paredes, Apartado 2306, Lima, Peru. Meets monthly except during January, February and March, at Asociación Médica Peruana "Daniel A. Carrión," Villalta, 218, Lima.

Sociedad de Radiologica, Cancerologia y Fisica Medica del Uruguay
Secretary, Dr. Arias Bellini, Av. Agraciada 1464, Piso 13, Montevideo, Uruguay.

Continental Europe

Société Belge de Radiologie
General Secretary, Dr. S. Masy, 111 Avenue des Allies, Louvain, Belgium. Meets monthly, second Sunday at Maison des Médecins, Brussels.

Société Française d'Electro-Radiologie Médicale, and its branches: Société du Sud-Ouest, du Littoral Méditerranéen, du Centre et du Lyonnais, de l'Ouest, de l'Est, et d'Alger et d'Afrique du Nord
Secretary-General, Dr. A. Dariaux, 9 bis, Boulevard Rochechouart, Paris IX^{e}, France.

Ceskoslovensk společnost pro rëntgenologii a Radiologii v Praze
Secretary, Dr. Roman Bláha, Praha XII, stát. nemocnice, Czechoslovakia. Meets monthly except during July, August, and September. Annual general meeting.

Polish Society of Radiology
Secretary, Dr. L. Zgliczynski, 59 Nowogrodzka St., Warsaw, Poland.

Gdansk Section, Polish Society of Radiology
Secretary, Dr. A. Smigielska, Akademia Lekarska, Gdansk. Meets monthly last Sunday at 10:30, X-Ray Dept., Akademia Gdansk.

Warsaw Section, Polish Society of Radiology
Secretary, Dr. L. Zgliczynski, 59 Nowogrodzka St., Warsaw, Poland. Meets monthly.

Societatea Romana de Radiologie si Electrologie
Secretary, Dr. Oscar Meller, Str. Banual Mărăcine, 30, S. I., Bucuresti, Roumania. Meets second Monday in every month with the exception of July and August.

All-Russian Roentgen Ray Association, Leningrad
USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs. S. A. Reinberg and S. G. Simonson. Meets annually.

Scandinavian Roentgen Societies
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association.

Sociedad Espanola de Radiologia y Electrologia
Secretary, Dr. J. Martin-Crespo, Fuencarral, 7. Madrid, Spain. Meets monthly in Madrid.

Schweizerische Röntgen-Gesellschaft (Société Suisse de Radiologie)
Secretary, Dr. Max Hopf, Effingerstrasse 47, Bern, Switzerland.

Deutsche Roentgen-Gesellschaft
Secretary, Dr. Peter Kröker, (22a) Essen-Helsingen, Westpreussenstrasse 21. Meets annually in different towns.

Societa Italiana dr Radiologia Medica
Secretary, Prof. Mario Ponzio, Ospedale Mauriziano. Torino, Italy. Meets biannually.

India

Indian Radiological Association
Secretary, Dr. R. F. Sethna, Navsari Building, Hornby Road, Bombay 1, India.

A SIMPLE METHOD OF OVERCOMING PYLOROSPASM

To the Editor:

Many attempts have been made to relieve the momentary pylorospasm which occurs during the course of gastric roentgenoscopy. Many and varied drugs have been advocated to overcome this spasm.

It is our opinion that frequently this pylorospasm is due to psychic factors associated with the examination. It is also frequently caused by distaste for the usual barium meal, whether flavored or not.

In this type of pylorospasm, we have found the use of flavored hard candies to be of great value.

As soon as it is evident, during the course of roentgenoscopy, that pylorospasm is present and that palpation cannot fill the duodenum, the patient is given a hard candy fruit-drop, with instructions to suck on it and not to swallow it. Usually within a very short time peristalsis begins and the sphincter relaxes with filling of the duodenal bulb.

This procedure is particularly effective in patients who are nervous or who actively express distaste for the opaque meal.

Lawrence A. Davis, M.D.
Everett L. Pirkey, M.D.

From the Department of Radiology
University of Louisville
Louisville, Kentucky

ANNUAL MEETING OF THE BRITISH INSTITUTE OF RADIOLOGY

It has been decided to re-establish the annual meeting of the British Institute of Radiology along the lines of the pre-War annual meeting. The dates fixed for this year are Thursday and Friday, December 4 and 5, 1952, and the meeting will be held in London, England, at Church House, Westminster, where the Hoare Memorial Hall, the Convocation Hall, and several other smaller rooms have been reserved. The program will be made as attractive as possible and it is hoped that this meeting will be as a great a success as were the pre-War annual meetings. With the kind cooperation of the Faculty of Radiologists and the Royal Society of Medicine, the annual meeting of the Institute will take the place of all radiological meetings in December.

The program will include:

A diagnostic symposium on "The Radiology of the Arterial System."
A therapy symposium on the subject of "Hypopharyngeal Cancer."
A radiobiology symposium which will deal with certain aspects of whole body irradiation.
A scientific exhibition.

It is also hoped to plan a short symposium primarily of interest to the engineers and industrial members. The Mackenzie Davidson Memorial Lecture, to be given by Professor S. Knutsson, has been planned for one evening, and a dinner will be held on the second evening.

COURSES IN RADIOISOTOPE TECHNIQUES

A course on advanced radioisotope techniques in biochemical research will be given by the Special Training Division of the Oak Ridge Institute of Nuclear Studies from November 3 to 14, 1952. The first week of the course will be devoted to techniques centering around the use of carbon 14. The second week will be concerned with the other major isotopes used in biochemical research. Applications must be filed by October 1, 1952.

The 30th, 31st and 32nd basic courses in radioisotope techniques in research will be offered by the Oak Ridge Institute of Nuclear Studies on January 5, February 2, and March 2, 1953.

Application blanks and other information concerning these courses may be obtained from Ralph T. Overman, Chairman, Special Training Division, Oak Ridge Institute of Nuclear Studies, P. O. Box 117, Oak Ridge, Tennessee.

UROLOGY AWARD

The American Urological Association offers an annual award of $1,000.00 (first prize of $500.00, second prize $300.00 and third prize $200.00) for essays on the result of some clinical or laboratory research in Urology. Competition shall be limited to urologists who have been in such specific practice for not more than five years and to men in training to become urologists. The first prize essay will appear on the program of the forthcoming meeting of the American Urological Association to be held at the Hotel Jefferson, St. Louis, Missouri, May 11–14, 1953.

For full particulars write the Executive Secretary, William P. Didusch, 1120 North

Charles St., Baltimore, Maryland. Essays must be in his hands before January 15, 1953.

Committee on Scientific Research
Miley B. Wesson, *Chairman*
John E. Heslin
Harry M. Spence

CORRECTIONS

The following are corrections which the authors (Robert M. Geist, Jr., and U. V. Portmann) wish made in their article entitled "Primary Malignant Tumors of the Nasopharynx" which was published in this Journal, August, 1952, *68*, 262–271:

Page 264, column 1

Reading—"The initial symptoms were in the upper respiratory tract in 21 of our 73 patients (28.7 per cent)."

Correct—"The initial symptoms were in the upper respiratory tract in 21 of our 72 patients (29.2 per cent)."

Page 264, column 2

Reading—"The initial symptoms in 15 of our 72 patients were neurologic (23.6 per cent)."

Correct—"The initial symptoms in 15 of our 72 patients were neurologic (20.8 per cent)."

PITTSBURGH ROENTGEN SOCIETY

At the meeting of the Pittsburgh Roentgen Society held on June 11, 1952, the following officers were elected: *President*, Dr. William T. Rice; *Vice-President*, Dr. J. E. Malia; *Secretary*, Dr. Donald H. Rice; *Treasurer*, Dr. Newton Hornick; *Councilor to the American College of Radiology*, Dr. S. G. Henderson.

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY

At the recent meeting of the Rocky Mountain Radiological Society held August 7, 8 and 9, 1952, at Denver, Colorado, the following officers were elected: *President*, Dr. H. Milton Berg, Bismarck, North Dakota; *President-Elect*, Dr. W. Walter Wasson, Denver, Colorado; *1st Vice-President*, Dr. Warren B. West, Ogden, Utah; *2nd Vice-President*, Dr. Donald H. Breit, Sioux Falls, South Dakota; *Secretary-Treasurer*, Dr. Maurice D. Fraser, Lincoln, Nebraska. A very successful meeting was held, there being over 225 registered members and visitors.

The next annual meeting is to be held in Denver, Colorado, August 20, 21, and 22, 1953, at the Shirley-Savoy Hotel.

SOUTH CAROLINA RADIOLOGICAL SOCIETY

At the last meeting of the South Carolina Radiological Society, held in conjunction with the annual meeting of the South Carolina Medical Association, the following officers were elected: *President*, Dr. Malcolm Mosteller, Columbia, South Carolina; *Vice-President*, Dr. G. Carroll Brown, Jr., Walterboro, South Carolina; *Secretary-Treasurer*, Dr. Henry E. Plenge, Spartanburg General Hospital, Spartanburg, South Carolina. By unanimous vote, the name of the society was changed from the South Carolina X-ray Society to the South Carolina Radiological Society.

BOOK REVIEWS

Books sent for review are acknowledged under: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interest of our readers as space permits.

Roentgen Anatomy. (Roentgen Anatomía.) By David Steel, M.D., St. John's Hospital and Evangelical Deaconess Hospital, Cleveland, Ohio. Cloth. Price, $8.00. Pp. 109, with 54 illustrations. Charles C Thomas, Publisher, 301 East Lawrence Avenue, Springfield, Illinois, 1951.

The problem of identifying and designating structures shown in reproductions of roentgenograms is difficult. The happiest solution is labelling the structures on an accompanying line diagram, and this is the method used in this atlas. All of the common views used in roentgenography and some of the less common ones are illustrated, one roentgenogram to a large page, and facing each is a corresponding line diagram, with numbers identifying the various anatomical features. The atlas covers only average normal structures; development, anatomical variants, and pathological changes are not considered.

While this atlas will not supplant, and is not intended to supplant, a textbook of anatomy or an atlas of gross anatomy, it will answer for the radiologist many of the questions usually referred to such texts, and it answers them quickly, concisely, and accurately. Throughout, emphasis is placed on the adult skeleton. The heart and great vessels are considered, but the other soft tissues, as in the cervical, abdominal, and pelvic regions, are not described. There are no illustrations of the normal structures which may be visualized using various contrast media.

The terminology is consistent throughout, being mainly Anglicized B. N. A. forms, and Latin names have been avoided. Some of the line drawings are difficult to read because of the large number of labels, and in many cases there is a different number for each of a series of similar structures, such as ribs, vertebral bodies, or pedicles. Although this makes some of the diagrams somewhat confusing, it probably adds to the usefulness of the book to a roentgenographic technician or a beginning roentgenologist, and completeness cannot be conceived as being a fault. The entire text is presented in Spanish as well as English without sacrificing convenience and without crowding. The English legend is given beneath the line diagram and the Spanish beneath the reproduced roentgenogram. The reproduction of the roentgenograms is good and the arrangement of the material on each page is excellent, permitting rapid and easy identification of the structures in question.

The book will find its greatest field of utility for the roentgenologist and roentgenographer, and is a valuable companion to a textbook of anatomy. It should be available to every radiological resident.

E. F. Lang, M.D.

Clinical and Roentgenologic Evaluation of the Pelvis in Obstetrics. By Howard C. Moloy, M.D., M.Sc., Assistant Clinical Professor of Obstetrics and Gynecology, College of Physicians and Surgeons, Columbia University, and The Sloane Hospital for Women. Paper. Price, $2.50. Pp. 119, with 68 illustrations. W. B. Saunders Company, West Washington Square, Philadelphia 5, Pennsylvania, 1951.

The publisher announces this as the first of a series of monographs intended to present results of research in special fields of medicine. The first 53 pages of this 119 page monograph deal with the general morphology of the pelvis. Pelvic types are described in great detail with ample illustrations, drawings, and diagrams of excellent quality. Analysis of the pelvis as presented by the author is indeed a worthwhile aid in evaluating the outcome of labor, but the radiologist with limited obstetrical experience will also benefit by the review of clinical obstetrics in subsequent chapters. Fetal positions, the mechanism of labor, and forceps operations are correlated with variations in pelvic size and shape, bringing out many facts of practical importance in roentgen pelvimetry.

Only a relatively small part of this monograph is devoted to the roentgen technique of pelvimetry and cephalopelvic disproportion. As is to be expected, the author stresses the precision stereoscopic technique, describing this method in detail, while other worthwhile

methods are merely casually mentioned.

This monograph is excellently illustrated, is easily read and should be of interest to the radiologist irrespective of the method of pelvimetry which he may employ.

Karl K. Latteier, M.D.

Verletzungen der Lungen und des Brustkorbes. Frühverlauf und Spätfolgen mit besonderer Berücksichtigung der Lungentuberkulose. Kritische Beobachtungen über 3 Jahrzehnte an fast 4000 Verletzten des Weltkrieges 1914/1918. Von Dr. Walter Steffens, Oberregierungsmedizinalrat i.R. ehemals Chefarzt der Versorgungsärztlichen Untersuchungsstelle Berlin. Paper. Price, DM 10.90. Pp. 319, with 45 illustrations. Georg Thieme, Diemershaldenstrasse, 47, Stuttgart, Germany, 1951.

This volume, the forty-fourth in a series of monographs published under the direction of the Ministry of Labor, is a comprehensive review of approximately 4,000 cases of thoracic injuries among military personnel sustained in World War I which the writer has followed from 1919 to 1944. He presents a careful statistical analysis of wounds of the chest wall and of the lungs, and summarizes in detail their early and later course. Pulmonary injuries are divided into penetrating wounds and those in which the missile remains lodged in the lung. Thoracic injuries comprised 6.2 per cent of German battle casualties; and of these 29 per cent did not penetrate the chest wall, 49.3 per cent penetrated the lungs, and in 21.7 per cent the foreign body remained lodged within the thorax.

Pneumothorax and hemothorax play a role in delaying the healing of the wound; but one of the determining factors in the severity of the early course of convalescence is the presence of infection and the development of empyema. The earlier this complication arises, the stormier is the course and the graver the prognosis. The incidence of empyema in the writer's series was 433, or 15 per cent, and of this number 15 per cent followed rib resection.

The late sequelae are of social as well as medical importance in their determining the extent of the patient's physical disability and the degree of impairment of his earning capacity. Pleural thickening, calcification and adhesions due largely to empyema comprise one group of late complications. Traumatic herniation of lung, while not common, caused 10 to 50 per cent disability. Among the late sequelae which resulted from damage to the lungs were hemoptysis (14.4 per cent), lung abscess (1.4 per cent), bronchitis (7.9 per cent) and bronchiectasis (2.3 per cent). Thoracotomy for removal of foreign bodies was not an uncommon procedure and carried a mortality of approximately 10 per cent as well as causing complications such as fistulae, empyema, and severe pleuritic changes. The author decries this practice and makes a plea for conservative medical management.

A considerable portion of the book is devoted to a discussion of the alleged relationship of pulmonary tuberculosis and thoracic injuries. The incidence of tuberculosis among the group investigated was 222, or 5.6 per cent, and the writer presents brief individual case histories of all these patients, accompanying many of them with roentgenograms of the chest. Among those with pulmonary injuries, 5.1 per cent contracted tuberculosis in contrast to those with injury limited to the chest wall who served as the control group and where the incidence was 7 per cent. Statistically and etiologically the evidence is against a causal relationship between thoracic injuries and the development of tuberculosis. In order to save space the author omitted the bibliography.

T. A. Gross, M.D.
E. A. Pohle, M.D.

Einführung in die Röntgenophotographie. Von Dr. Dr. Ing. e.h. John Eggert, O. Professor an der eidg. techn. Hochschule, Zürich. Unter Mitwirkung des Röntgen-Institutes am Kantonsspital Zürich. Direktor: Dr. H. R. Schinz, O. Professor an der Universität Zürich. Siebente Auflage. Paper. Price, Fr. 20.—. Pp. 236, with 65 illustrations. S. Hirzel Verlag, Claridenhof, Gotthardstrasse 6, Zürich 2, Switzerland, 1951.

In this "Introduction to Roentgenography" the author devotes the first part to theoretical considerations of such basic subjects as the production and nature of roentgen rays, their effects upon passage through matter, optical laws applicable to the production of roentgenographic images, and the relation of the quality of films to technical factors. The second section, comprising some two-thirds of the book, deals with the more practical aspects of roentgenography, including a discussion of transformers,

valve tube rectification, roentgen tubes, and roentgen-ray circuits. This section, although somewhat sketchy, is concise. A lengthier chapter on medical exposure technique follows, and here the author discusses the technical factors employed in taking roentgenograms of specific organs of the various systems. This section contains excellent reproductions of negatives selected by Schinz. The writer treats this subject somewhat generally and does not go into detail on positioning and technical factors. Of practical value is the final section on films, cassettes, and processing, including an outline of the more common errors resulting in unsatisfactory roentgenograms. The book concludes with several tables giving the exposure technique for the various parts of the body.

The book is well written and prepared. It cannot be regarded as a complete manual, but should serve, as its title indicates, to acquaint the student technician with his subject.

T. A. Gross, M.D.
E. A. Pohle, M.D.

The Management of Fractures, Dislocations, and Sprains. By John Albert Key, B.S., M.D., St. Louis, Missouri, Clinical Professor of Orthopedic Surgery, Washington University School of Medicine, etc.; and H. Earle Conwell, M.D., F.A.C.S., Birmingham, Alabama, Associate Professor of Orthopaedic Surgery, University of Alabama School of Medicine, etc. Fifth edition. Cloth. Price, $16.00. Pp. 1232, with 1195 illustrations. C. V. Mosby Company, 3207 Washington Boulevard, St. Louis 3, Missouri, 1951.

Nearly twenty years ago two orthopedic surgeons, one with a mind continuously impelled toward the why and wherefore of the reactions of tissue to disease, damage and repair, and the other exposed to an unusually rich experience in skeletal trauma, brought out a volume which was epochal in its succinct coverage of the nature and management of skeletal trauma. This volume was an invaluable asset to the student and general practitioner, and there could have been few among their colleagues in the field who did not find in it items of personal benefit.

The fifth edition of this work has recently been published. In its third edition it became a volume nearly twice as large, partly through the much more extensive introduction of roentgen anatomical and photographic illustrations, and partly by introducing new chapters covering sequelae, complications and rehabilitative procedures. The fourth edition in 1946 brought in the results of experience from World War II, as well as other advances in a five year period, was enthusiastically received and was reprinted the following year.

The authors visualized for this fifth edition the need for introduction of methods developed in this period for intramedullary fixation, as well as new or modified measures in the handling of compound fractures. While this edition can certainly still be considered as profusely illustrated, some of the less valuable have been deleted, and by shortening the text here and there by further conciseness, the additions have been possible with a slight reduction in the size of the volume, which, however, is still one of over twelve hundred pages. But in addition to the extensive illustration, the size of the volume is really consequent on its coverage and it would hardly seem possible that any section could be abbreviated without important loss. It would be doubtful if any aspect of bone or joint trauma of any importance, could present itself without finding in this volume adequate explanation of mechanism, diagnosis and management.

In an intensive search for any basis of critical comment the reviewer might make the following observations. In the discussion of delayed and nonunion a little more emphasis might be placed on the precept that in the presence of bone apposition and good alinement, but fibrous union only, solid bony union can be brought about long after the normal (and very variable) time of repair by functional activity in the presence of adequate external support. For with the average surgeon there are very definite risks in such major operative intervention, and even with the most skilled, union is secured considerably less than 100 per cent of the time.

The authors seem to be very much at the front of the trend to ascribe the etiology of most chronic low back disabilities, especially those with "sciatica," to intervertebral disc lesions. Unquestionably these are traumatic sequelae of rather high incidence. In a rather large series of surgery of the disc lesion, one of the authors obtained complete relief of pain and disability in about 40 per cent and minimal residuals in another 45 per cent, a very gratify-

ing accomplishment as statistics go for this disorder. But it also should not be overlooked that the authors relieved about 80 per cent of patients with this syndrome without surgery.

The section on relief of nonunion of femoral neck fractures would have been more adequate with the addition of illustrations of repair through osteotomy and of the use of internal fixation in this procedure. The reviewer is inclined to consider also that the management of the Cotton or trimalleolar fracture-dislocation of the ankle was a bit oversimplified, with more stress possibly indicated on the bed results from incomplete anatomical reduction of the posterior tibial element. It also might have been suggested that manipulation with aid of Kirschner wire traction on the tuber calcanei can often achieve a result that would obviate an otherwise necessary open reduction.

The section on intramedullary nailing of the femur might well have been extended to cover some of the pitfalls easily encountered in this procedure, as well as the matter of selection of type of fracture most suitable.

Perhaps, after all, in this volume the most valuable and unique contributions to textbook coverage of the subject are the sections on injuries in and around joints, always the bête noire of the most skilled. This subject is covered most exactly as to normal and pathological anatomy, the specific measures of management for each type, with most instructive illustrations, and is possibly the most praiseworthy aspect of a generally quite invaluable treatise.

Charles Peabody, M.D.

Vernal Conjunctivitis. By M. N. Beigelman, M.D., Clinical Professor of Surgery (Ophthalmology), University of Southern California School of Medicine, Senior Attending Ophthalmologist, Cedars of Lebanon Hospital, Attending Eye Pathologist, Los Angeles County Hospital. With a Foreword by Sir W. Stewart Duke-Elder, K.C.V.O., M.A., D. C. (St. And.), Ph.D. (Lond.), M.D., Ch.B., F.R.C.S., Hon. D.Sc. (Northwestern). Cloth. Price, $6.00. Pp. 430, with 49 illustrations. University of Southern California Press, Los Angeles, California, 1950.

Vernal Conjunctivitis by M. N. Beigelman, M.D. is well written and comprehensive. It will serve as the reference book on this subject. The investigative work for the subject is well carried out, and some fine illustrations for the pathology are included.

The bibliography is complete and every phase of the condition has been studied and reported. The section on therapy is complete, although it may require some knowledge of the subject on the reader's part to decide the most efficient therapy.

The recent advent of ACTH and cortisone has added at least another paragraph to the therapy. It probably should be stressed more fully that discomfort is the most important factor causing the patient to consult a physician, and the relief thereof will allow for complete study and prolonged therapy.

I would recommend this book for its completeness and believe every oculist would benefit by reading it and using it for reference.

A. D. Ruedemann, M.D.

Radiologic Physics. By Charles Weyl and S. Reid Warren, Jr., Moore School of Electrical Engineering, University of Pennsylvania. With a Foreword by Eugene P. Pendergrass, M.D., Director of the Department of Radiology, University of Pennsylvania. Second edition. Cloth. Price, $10.50. Pp. 491, with numerous illustrations. Charles C Thomas, Publisher, 301 East Lawrence Avenue, Springfield, Illinois, 1951.

This is the second edition of the popular book by Weyl, Warren and O'Neill. Like the first edition, it is divided into two roughly equal parts. The first part provides the engineering background required to understand the functioning of electrical equipment used in radiology. The topics include electromagnetism, circuit theory, electrical measuring instruments, transformers, high voltage generators and electronics. The latter topic has been considerably expanded in line with the considerable development in this field since the first edition. While these topics may appear formidable to the beginner, the authors have made a real and generally successful effort to start each one from the basic facts and develop it thoroughly. The engineering details included here, however, do not fit well under the present title. Perhaps a better title choice would have been Radiologic Engineering and Physics.

The second half of the book deals with the production of radiation as well as its effect on and its modification by matter. Topics covered

in this portion of the book include the characteristics of wave motion, the production of roentgen rays and radiations from radioactive substances, the interaction of these radiations with matter, the measurement of roentgen and gamma rays, and a discussion of the physical factors affecting therapeutic, roentgenoscopic and roentgenographic techniques. The appendix contains a brief discussion of the elements of mathematics required to follow the text plus a series of mathematical tables required to solve simple radiologic physics problems.

The field of radiologic physics is generally well covered in this book and the important points are illustrated by solved problems. The material on dosimetry, however, could stand some minor modifications. The discussions of the roentgen definition and of the requirements for its measurement are excellent, but an indication of the magnitude of the change in calibration of photographic film badges and cavity chambers with photon energy would be helpful in interpreting the results obtained from them. Deletion of the obsolete gamma roentgen and the J unit in favor of further discussion of the energy unit would probably be of more assistance to the new student.

Harold O. Wyckoff

Annual Report on Stress. By Hans Selye, M.D., Ph.D. (Prague), D.Sc. (McGill), F.R.S. (Canada), Professor and Director of the Institut de Médecine et de Chirurgie expérimentales, Université de Montréal. Cloth. Price, $10.00. Pp. 511, with numerous illustrations. Acta Inc., 5465 Décaire Boulevard, Montreal, Canada, 1951.

This is the first annual report on stress by Selye whose name is synonymous with the "General Adaptation Syndrome." In this volume he deals with about 3,000 references which have to do with the general adaptation syndrome, most of which were published during the past academic year. Selye unquestionably has gathered together a most voluminous literature on the endocrines, requiring, no doubt, a large staff to correlate the material. He has been able to gather this literature by requesting reprints from more than 2,000 investigators and that he be kept on their mailing list. A distinguishing feature is that the text of 511 pages is printed on white paper whereas the 133 pages of references are printed on yellow paper. The volume is divided into two main sections.

A. The General Physiology and Pathology of Stress.

B. The Special Physiology and Pathology of Stress.

In the first few pages he answers his critics, following this by comments made by those giving general approval of his theory.

He then gives a synopsis of the stress concept as it presents itself in 1951.

He takes up the stressor agents, the chemistry and pharmacology of the adaptive hormones.

The various metabolisms, drugs, ACTH, cortisone, steroids are discussed. The different systems of the body with application of the general adaptation syndrome when these systems become diseased are also discussed.

The book is difficult reading and one can hardly read it continuously. Selye himself said this and states it is useful as a reference book on stress and not to be read from cover to cover. The abbreviations used such as "G. A. S." for General Adaptation Syndrome, "M. C." for Mineral Corticoids, "G. C." for Glucocorticoids indicates that one must ever be alert when reading the sentences. A great deal of work both in the form of experimental research, and correlation of the voluminous literature has gone into the book.

Regardless of whether one agrees with Selye's concept, it has had a striking impact on modern medical thinking as evidenced by the 3,000 references made to his work. Undoubtedly the discovery of ACTH and cortisone helped focus attention on the Adaptation Syndrome. Time unquestionably will modify the concept and the evidence placed in the crucible of experience will separate the dross from the factual truths.

Robert C. Moehlig, M.D.

ABSTRACTS OF RADIOLOGICAL LITERATURE

Department Editor: T. Leucutia, M.D., Harper Hospital, Detroit 1, Michigan

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ROENTGEN DIAGNOSIS

Head

Torgersen, Johan. Hereditary factors in the sutural pattern of the skull. *Acta radiol.*, Nov., 1951, *36*, 374–382.

The evidence to date suggests that the suture pattern of the skull must be considered as a whole from the point of view of genetics even if particular sutures and ossification centers are relatively independent. The sutures in the metopic skull usually close rather late. There are probably two groups of genes which influence the suture pattern of the skull, one determining the situation of the ossification centers and the sutures, and the other determining the rate of obliteration of the suture lines. It is probable that the effect of these genes is influenced by the blood supply.

When the peculiar relationship between the pineal gland and the cranial sutures in some reptiles and amphibians is considered together with the close topographical relationship of the pineal gland to branches of the choroid arteries, the straight sinus and the vein of Galen, it seems probable that the pineal gland may be essential to the vascular mechanism. By some such means it is postulated that the genes may have their affect on suture closure. The author suggests that a study of the connection between calcification of the pineal gland and suture closure may throw some light on the obscure function of the pineal gland.

The case of one family is described in which the metopic suture was observed in three generations. It was found in the maternal grandmother seventy-five years old, in the mother fifty-two years old and in 2 of her 3 children both of whom were over twenty. One of the latter (a female) had a typical metopic suture in which neither ectocranial nor endocranial closure had commenced. Her brother had a typcial picture of "vicious union" with piling up of bone along the edges of the endocranial part of the supraglabellar portion of the suture. In "vicious union" which is especially common in the sagittal and lambdoid suture, the suture may never close. The occurrence of this disconcerting phenomenon of suture closure in this family is evidence of its heritability. "Vicious union" when observed in females over forty-five years of age apparently has a relationship to the frontal hyperostosis which is so common in this age group. This is illustrated in the case of the mother in whom there was a remarkable degree of sclerosis along the metopic suture (of which the endocranial part only was visible). In the grandmother the suture was observed as a fracture-like line running through the septum of the frontal sinus. Both the mother and the grandmother had calcification in the falx. Admitting that such calcification is rather common, its occurrence in the mother and grandmother is remarkable considering the relationship between ossification, suture closure and the meningeal membranes. (One may consider that these shadows probably represented true bone and not simple calcification.)—*Mary Frances Vastine, M.D.*

Fischgold, H., and Metzger, J. Signes radiographiques discrets et précoces des atrophies cérébrales unilatérales. (Early and discrete roentgenographic signs of unilateral cerebral atrophy.) *J. de radiol. et d'électrol. & Arch. d'électric. méd.*, 1951, *32*, 733–741.

The unilateral atrophy of the brain results in difference in pressure between the two sides. The skull tends to fill the vacancy in the atrophic side. These differences in pressure result in a smaller hemicranium on the atrophic side, unilateral expansion of all the air sinuses save the maxillary sinus, a constantly thickened skull, a deviation of the crista galli towards the atrophic side, an elevation of the groove of the lateral sinus towards the atrophic occipital lobe, and finally, narrowing of the temporal fossa with thickening of the greater wing of the petrous portion of the temporal bone. This last sign is best elicited by anteroposterior laminagraphy.

The two sides of the cranium are never symmetrical in normal individuals. In these studies the roentgen findings were correlated with the EEG findings, and the clinical signs. Ventriculograms were also studied.

The authors present a series of roentgenograms with the intention of demonstrating discrete and early signs of unilateral cerebral atrophy. These signs are: (a) thickening of the superior border of the petrous portion of the temporal bone, demonstrated in the fronto-occipital view; (b) asymmetry of the borders of the groove of the superior longitudinal sinus; (c) deviation of the crista galli towards the atrophic side, and prominence of the ethmoid and sphenoidal sinuses on that side; (d) rarefaction of the anterior clinoid process; (e) a double contour of the inner tables of the skull on a lateral film.

The earliest sign of unilateral atrophy is displacement of the anterior superior fontanel, which may later disappear and then displacement of the temporal suture becomes evident.—*Najib Abu-Haydar, M.D.*

Neck and Chest

Statland, Harry, Wasserman, Marvin M., and Vickery, Austin L. Struma lymphomatosa (Hashimoto's struma); review of fifty-one cases with a discussion of the endocrinologic aspects. *Arch. Int. Med.*, Nov., 1951, *88*, 659–678.

Struma lymphomatosa is a disease occurring primarily in women during the fifth and sixth decades. A few cases have been observed in children. It is

characterized by enlargement of the thyroid up to ten times the normal size, usually diffuse and symmetrical. In addition to the mass in the neck, the chief complaint results from pressure, dysphagia, cough, dyspnea, and a varying degree of hypothyroidism.

The enlarged thyroid is lobulated and firm with a "rubbery" consistency; average weight is 66.8 grams; largest, 222 grams, normal, 20 grams. On cross section, a homogeneous appearance is manifest, similar to that of a hyperplastic lymph node. Histopathologically, there is an abundance of lymphoid tissue diffusely distributed throughout the thyroid gland, varying from light sprinkling of lymphoid tissue in the parenchyma to the formation of germinal centers. There is parenchymal degeneration, and fibrosis is not prominent. Occasionally, hyperplasia of regional lymph nodes is noted.

Reviewing the records of the Massachusetts General Hospital between 1930 and 1949, the authors found 51 cases of struma lymphomatosa out of 140 cases of chronic thyroiditis. Also out of 3,676 thyroid operations, 51 were for struma lymphomatosa—1.4 per cent of all thyroidectomies.

Etiology is not determined. There is no associated previous infection or thyrotoxicosis. Routine laboratory tests gave no characteristic results. Basal metabolic rates ranged from +16 to −33 per cent, with an average of −8.3 per cent. The result of protein-bound-iodine studies on 3 cases was 0.9, 2.5, and 4.4 gammas per 100 cc. respectively. The first is in the myxedema range and the latter two are indicative of hypothyroidism. Tracer doses of radioactive iodine (100 microcuries of I^{131} with 100 gammas of sodium iodide as carrier) were given to 7 patients and the urinary excretion of radioactive iodine was determined for forty-eight hours. The uptake of I^{131} by the thyroid was computed as 33.6 per cent which is in the lower range of normal.

Radioautography of histologic specimens in 3 cases (tracer doses of 500 microcuries of I^{131} administered one day prior to thyroidectomy) demonstrated no uptake of radioactive iodine in areas of lymphatic infiltration, while areas of degenerating follicles showed a small amount of darkening of the radioautographic film indicating activity of the thyroid tissue. This may explain the absence of frank myxedema in these cases.—*W. H. Shehadi, M.D.*

Lowenhaupt, Elizabeth, and Brown, Reynold. Carcinoma of the thymus of granulomatous type; a clinical and pathological study. *Cancer*, Nov., 1951, *4*, 1193–1209.

Thymic carcinoma of granulomatous type occurs in young adults and is often confused with Hodgkin's disease. It presents as a large mass in the anterior superior mediastinum. Distant metastases do not occur as the tumor does not spread by embolic process, but rather by direct extension to adjacent organs and/or retrograde growth through lymphatics. Retroperitoneal, pulmonary, and supracervical lesions arise as a result of the latter. The liver and spleen are involved only if there is direct downward extension through the pleura and diaphragm. The sternum and chest wall may be invaded by direct anterior growth.

Surgery in resectable cases may produce complete cure. Roentgen therapy is indicated in all other cases and may produce prolonged arrest. The optimal dose has not been established, as response varied considerably in this series. The authors' presently believe that 5,000–6,000 r to the tumor in forty to forty-five days is most effective. The duration of life from the time of initial diagnosis was from one to more than five years. It apparently depends somewhat on the individual tumor.

Nine cases are presented and discussed. The histopathologic features of this neoplasm are reviewed.—*R. A. Silver, M.D.*

Rossi, Lucio. Pneumomediastino mediante retropneumoperitoneo. (Pneumomediastinum by means of retropneumoperitoneum.) *Ann. radiol. diag.*, 1951, *23*, 420–429.

Ruis Rivas has described how oxygen injected into the pararectal area can be utilized to produce a retropneumoperitoneum, and eventually a pneumomediastinum. The author, who has used Condorelli's technique for producing pneumomediastinum, disagrees with Rivas' statement—that pneumomediastinum probably has very little practical importance. He stresses that with the aid of laminagraphy, air within the mediastinum permits the visualization of the structures contained therein to better advantage.

Three hours after 1,000–2,000 cc. of gas has been injected into the pararectal space—laminagrams of the chest are taken at levels of 9, 11, 13, 15 cm. The patient lies in a lateral horizontal position during the exposures. The large vessels, the thymus and pleural reflections are clearly shown and the author submits films and diagrams to emphasize this point.

This method of obtaining a total pneumomediastinum (anterior and posterior) has the following advantages: Only one injection site is necessary, which is easy to perform with no danger of injury to the large vessels of the mediastinum; it is also completely aseptic and causes very little discomfort to the patient. The author believes that now that pneumomediastinum has become so simple a procedure its widespread use will follow.—*P. E. Russo, M.D.*

Storey, Clifford F., and Lyons, Harold A. Tuberculomas of the mediastinum. *Am. Rev. Tuberc.*, Oct., 1951, *64*, 327–352.

Tuberculomas of the mediastinum are regarded as medical rarities. Review of the literature uncovers only 8 cases of surgically excised mediastinal tuberculomas. These were all located in the superior medi-

astinum. Five were on the right and 3 were on the left side.

In the period from 1947 to 1950, 6 cases of mediastinal tuberculoma have been observed at the U. S. Naval Hospital, St. Albans, New York. Five were proved at operation; the sixth case is under observation.

The anatomic location of the mass in 10 of the 14 cases (considering both the cases in the literature and the personal ones) was immediately above the transverse portion of the azygous vein, lateral to the inferior portion of the superior vena cava and anterolateral to the trachea. The lesions were usually oval or spherical in shape and smooth in contour.

Roentgenographically in frontal projection a typical case will show a smoothly outlined, rounded mass of uniform increased density projecting to the right of the mediastinum with its inferior border at the level of the crotch formed by the junction of the azygous vein and superior vena cava. Stereoscopic and lateral projections show the mass is situated along the anterolateral tracheal wall. The lesion is usually solitary. This is in contradistinction to tuberculous mediastinal nodes which are usually multiple and commonly are bilateral. Calcium was not demonstrable by standard or by Potter-Bucky roentgenograms.

In all of the present series of 6 cases tuberculin, histoplasmin and coccidioidin skin tests were done. Two of the 6 were tuberculin negative, all were negative for histoplasmosis and coccidioidomycosis. Sputum examinations were done in each case and angiocardiography was almost routinely used. The conclusion is reached that tuberculomas of the mediastinum are more common than generally believed and should be prominently considered in differential diagnosis of mediastinal lesions.—*E. E. Julien, M.D.*

Treves, Norman, and Sunderland, Douglas A. Cystosarcoma phyllodes of the breast: a malignant and a benign tumor; a clinicopathological study of seventy-seven cases. *Cancer*, Nov., 1951, *4*, 1286–1332.

The authors give an excellent survey of this unusual tumor of the breast starting with Müller's original description of "cystosarcoma phyllodes" in 1838. In 1931 Lee and Pack collected 111 cases reported up to that date. In the present article 12 cases of malignant cystosarcoma are analyzed in detail.

Clinically cystosarcoma phyllodes of the breast is defined and characterized (1) as usually being bulky in size; (2) as being encapsulated with infrequent invasion of adjacent tissue; (3) as developing from preexistent fibroadenoma; (4) as showing either initial quiescence or slow growth followed by sudden rapid phase; and (5) as having a good prognosis with relative freedom from recurrence.

In the *differential diagnosis* the following possibilities are often considered: (1) breast hypertrophy, either unilateral or bilateral; (2) lipoma; (3) bulky adenocarcinoma; (4) osteoid sarcoma; (5) angiosarcoma—probably the most rapidly growing breast sarcoma which may give a purplish color to the overlying skin, and occurs in girls and young women; (6) liposarcoma—a tumor of fat rather than breast; and (7) rarely lymphomas—usually lymphosarcoma and less frequently Hodgkin's disease.

The only difference between cystosarcoma phyllodes and fibroadenoma of the mammary gland is the smaller size and lessened cellularity of the latter. Foote and Stewart described the malignant aspect of cystosarcoma in 1946. These malignant and borderline lesions are very frequently over 15 cm. in diameter. Blood strema invasion as well as local recurrence appears to be the chief feature of malignant breast cystosarcoma with note to date of only 1 case of lymphatic axillary metastases.

Full term pregnancies were conspicuously absent in 9 cases of the malignant type of this unusual tumor out of a total of 77 cases reviewed from Memorial Hospital, New York, from 1930 to July, 1949. The authors suggest that "benign" or "malignant" should be adjectively used in specifying the type of cystosarcoma phyllodes of the bresat.

Histopathologically, it is interesting to note that the presence of bizarre giant cells in an otherwise benign appearing stroma does not indicate malignant oncological conduct. The earliest indications of cellular misconduct are still anaplasia and focal subepithelial stromal cellularity.

The *treatment* previously recommended was simple mastectomy, but now wider excision with removal of the major pectoral muscle appears indicated.—*E. H. Price, M.D.*

Tori, Giulio. Radiological visualization of the coronary sinus and coronary veins. *Acta radiol.*, Nov., 1951, *36*, 405–410.

The author states that catheterization of the coronary sinus may be carried out quite easily provided certain technical rules are heeded. After having introduced the catheter into the right aurical under roentgenological control, the patient is placed in the right anterior oblique position and the tip of the catheter is directed towards the tricuspid valve. Instead of pushing the catheter downwards and endeavoring to go beyond the valve, it is rotated slightly and an attempt is made to direct it toward the posterior wall of the auricle. After several such attempts the catheter will usually enter the coronary sinus.

The roentgen findings which suggest that the catheter has entered the coronary sinus include: (1) In the left anterior oblique position, the catheter point is seen exactly at the posterolateral outline of the heart so that there is no visible space between the outer surface of the heart and the tip of the catheter. (2) The arrest of the catheter on the pos-

terolateral border of the heart makes it impossible to advance it further even with slight pressure.

When catheterization of the coronary sinus is done in conjunction with injection of the contrast medium through the catheter, the lumen of the sinus is readily demonstrated as well as the lumens of the larger coronary veins directly succeeding the sinus.

Two cases in which visualization of the coronary sinus and the coronary veins were obtained are reported by the author.—*Mary Frances Vastine, M.D.*

Smith, Warren W., Albert, Roy E., and Rader, Bertha. Myocardial damage following inadvertent deep cannulation of the coronary sinus during right heart catheterization. *Am. Heart J.*, Nov., 1951, *42*, 661–666.

A case with clinical evidence of myocardial damage developed following cardiac catheterization is presented. During the catheterization, the second in twenty-six days, a 9½ F. double lumen catheter passed through the tricuspid valve to a point about 7 inches beyond, where the pressure wave showed a coronary sinus pattern. The catheter was obviously deep in the coronary venous tree, probably in the the great cardiac vein, and was withdrawn immediately. Hypotension, precordial pain, fever, and cough began and persisted for several days. Electrocardiographic changes developed immediately on introduction of the catheter into the coronary sinus, and subsequently assumed the configuration characteristic of pericarditis.

Several investigators have shown that the insertion of a catheter tip into the coronary sinus for a short distance may be innocuous; there is evidence that the coronary venous tree may tolerate a small catheter even if inserted deeply. A catheter with relatively large outside diameter inserted deeply is dangerous, however. Therefore, the catheter should always be observed fluoroscopically in the right anterior oblique position during passage through the tricuspid valve area to avoid insertion into the coronary sinus.

(McMichael and Mounsey [*Brit. Heart J.*, July, 1951, *13*, 397–402] recommend the left anterior oblique position during fluoroscopic guidance of the catheter, whereby the catheter tip is seen to go *posteriorly* after passing through the tricuspid valve if the coronary sinus is entered. Normally, the catheter tip is in this position [left anterior oblique] directed *anteriorly* through the right ventricle into the outflow tract of the ventricle).—*Harold Fulton, M.D.*

Marchand, Ernesto J., Hejtmancik, Milton R., and Herrmann George R. Extracardiac arteriovenous fistulas in the thorax. *Am. Heart J.*, Nov., 1951, *42*, 682–697.

Theoretically there are five different types of extracardiac arteriovenous communication within the thorax: (1) aorta and pulmonary artery; (2) aorta or peripheral systemic artery and systemic vein; (3) pulmonary artery and pulmonary vein; (4) aorta and pulmonary vein; and (5) pulmonary artery and systemic vein. Each type represents a distinctive syndrome and a diagnosis can usually be made on the basis of clinical findings. Roentgen studies contribute valuable additional data.

In the past year, cases of each of the first three types were studied by the authors.

Aorta to pulmonary artery. The communication is usually produced by rupture of an aortic aneurysm into the main pulmonary artery or right or left pulmonary trunk. Before the rupture, the aneurysm may cause stenosis of the pulmonary artery by pressure. At the time of rupture there is sudden severe pain, collapse or shock, severe dyspnea, and finally right heart failure. The severity of symptoms depends on the size of the fistula and the pressure effects upon the other mediastinal structures. A continuous thrill and harsh murmur are present in the region of the left second and third interspaces, while peripheral signs are those of aortic insufficiency. The course is usually retrogressive with death in a few weeks or months after the rupture.

Roentgenologically, besides the aortic aneurysm, there is usually cardiac enlargement with prominent pulmonary artery, pulmonary congestion, and pleural effusion. The authors' case was also studied by cardiac catheterization which by pressure and oxygen studies showed a shunt from the aorta to pulmonary artery.

Aorta to superior vena cava. Clinically, the onset is sudden and dramatic with signs of superior vena cava obstruction, *i.e.*, cyanosis, edema, and venous distention, all involving the upper half of the body.

The case presented showed on roentgen examination a large mass in the right anterior chest which at postmortem proved to be a large (13 cm. diameter) aneurysm which compressed the superior vena, cava and eroded it at one point forming a fistula with 3 cm. diameter.

Pulmonary artery to pulmonary vein (pulmonary arteriovenous fistula). This type presents the well known clinical picture of cyanosis, polycythemia, clubbing of fingers, and normal heart and spleen. One-half of the cases are associated with telangiectasis of skin and/or mucous membrane (Osler-Weber-Rendu syndrome).

The roentgenologic features have been described by Lindgren (Roentgen diagnosis of arteriovenous aneurysm of the lung. *Acta radiol.*, 1946, *27*, 585). The lesions exhibit circumscribed and slightly lobulated shadows of increased density in the lungs which are connected with the hilar vessels by tortuous bands of increased density representing dilated pulmonary vessels. Fluoroscopically, the masses often pulsate and change size in relation to variations of intrathoracic pressure. They become smaller with

the Valsalva test and larger with the Müller maneuver. Angiocardiography is a valuable aid.

The reported case is the second such described—pulmonary hemangioma with superimposed subacute bacterial endocarditis. All the clinical and roentgenologic features of an arteriovenous fistula of the lung were illustrated by a mass in the right lung. At operation a cavernous hemangiomatous arteriovenous fistula of the right upper lobe was removed. Two smaller similar lesions in the right middle and right lower lobes were also found at operation and removed, illustrating the advisability of preoperative angiocardiography with visualization of all lung fields to demonstrate the frequently multiple lesions.—*Harold Fulton, M.D.*

Skapinker, Samuel. Diverticulum of the left ventricle of the heart; review of the literature and report of a successful removal of the diverticulum. *Arch. Surg.*, Nov., 1951, *63*, 629–634.

Diverticulum of the left ventricle of the heart is so rare that only 13 cases have been reported in the literature. Only 1 patient lived beyond infancy without surgery and he died at the age of four years due to rupture of the diverticulum.

The diverticulum occurs before the diaphragm is developed and in most cases the diverticulum passes through a parasternal hiatus. However, if found above the diaphragm the diverticulum must have formed after the diaphragm fused.

The case reported by the author was operated upon, the second on record. A pulsating tumor was present at the umbilicus. Angiography was performed to aid in the diagnosis. Although the postsurgical course was stormy the baby is still alive and well. Because most patients die within the first few months of life, the author feels that operative removal should be attempted.

A chart of data on reported cases, reproduction of roentgenograms, a photograph of the surgical specimen and schematic illustration of the condition are included in the article.—*A. F. Rossitto, M.D.*

Rutstein, David D., Williamson, Charles R., and Moore, Felix E. Heart disease case finding by means of 70 millimeter photofluorographic films; group I. *Circulation*, Nov., 1951, *4*, 641–651.

The first paper in this series presents the results of heart disease case finding in the Boston Chest X-Ray Survey for Tuberculosis using 70 millimeter photofluorographic films which were read by the survey team for all abnormalities and then were re-read by a group of selected radiologists. This group of "special" readers classified films as abnormal at three times the rate of the "regular" readers, but with almost the same degree of precision.

This study involved 31,091 patients of which 3.54 per cent had abnormal cardiac shadows. A high percentage of those classified as abnormal were re-examined and heart disease verified in 59.6 per cent.—*W. A. Klauber, Jr., M.D.*

Williamson, Charles R., Moore, Felix E., and Rutstein, David D. Heart disease case finding by means of 70 millimeter photofluorographic films; group II. *Circulation*, Nov., 1951, *4*, 652–658.

This survey is based on 99,791 films made for routine chest survey work at the Boston Chest X-Ray Survey where the conditions are the usual for mass surveys. From this group 410 cases (0.41 per cent) were reported to have abnormal cardiac shadows. Of this group, approximately 75.4 per cent were verified as having heart disease. Most of the previously unknown cases of heart disease were classified into the categories of hypertension, hypertensive and arteriosclerotic heart disease, arteriosclerotic, and rheumatic heart disease in this order.—*W. A. Klauber, Jr., M.D.*

Rutstein, David D. Screening tests in mass surveys and their use in heart disease case finding. *Circulation*, Nov., 1951, *4*, 659–665.

This article embodies a discussion of the subject of mass survey studies in general. Evaluation of a particular system of mass survey is based primarily upon reliability of the mass test as well as the validity of the test used.

The principles governing the use of screening tests in mass surveys are discussed. Evaluation is made by a consideration of the yield of previously unknown cases, cost per case found, and acceptance of the survey by the local physician, and the community in general.—*W. A. Klauber, Jr., M.D.*

Soloff, Louis A., Stauffer, Herbert M., and Zatuchni, Jacob. Ebstein's disease; report of the first case diagnosed during life. *Am. J. M. Sc.*, Nov., 1951, *222*, 554–561.

Ebstein's disease is a congenital malformation of the heart characterized by a downward displacement of an anomalous tricuspid valve that divides the right side of the heart into a large auricular portion consisting of the true aurical and the greater portion of the ventricle and a smaller ventricular portion consisting of the lower portion of the ventricular cavity with its outflow tract. The leaflets of the tricuspid valve are anomalous in development and may be fused together.

The purpose of this report is to describe the first instance of Ebstein's disease diagnosed during life and to re-emphasize the characteristic clinical syndrome that was not obscured by the presence of an unrelated severe hypertension.

A white woman, aged thirty-four, was first seen

January 19, 1951, for treatment of hypertension. Unusual features suggested an associated congential cardiac difficulty. These included history of a murmur at the age of nine years, the finding of a systolic thrill and murmur in the third intercostal space parasternally, an enlarged cardiac silhouette, the right auricular segment particularly, giant P waves in the electrocardiogram, a bundle branch block, and prolonged right heart circulation time. Angiocardiographic studies were done using a biplane unit permitting simultaneous exposures at right angles to each other on roll film at the rate of two per second. Right and left anterior oblique projections were obtained over an interval of fifteen seconds. These studies, as in valvular pulmonic stenosis, revealed a delayed emptying of the contrast material from the right heart but, unlike valvular pulmonic stenosis, a narrow band of greater transparency was shown in the most anterior portion of the heart in the right anterior oblique position becoming demarcated in the later exposures. This was considered to represent a tricuspid valve leaf. To the right of this shadow the contrast filled chamber was believed to represent the "auricularized" right ventricle, while the segment to the left of this shadow represented the functioning inferior tip of the right ventricle. This patient is still alive.—*Paul R. Dirkse, M.D.*

Carlens, Eric, Hanson, Hans Erik, and Nordenström, Björn. Temporary unilateral occlusion of the pulmonary artery; a new method of determining separate lung function and of radiologic examinations. *J. Thoracic Surg.*, Nov., 1951, *22*, 527–536.

Even after a study of circulation by cardiac catheterization and a study of pulmonary function of each lung by bronchospirometry, it is often difficult to decide whether or not an individual lung can be safely removed. In doubtful cases it would be highly desirable if it were possible before operation to temporarily put the patient in a state which so far as possible resembled the functional condition after operation.

In a preliminary experiment on dogs and in 3 cases on humans, the pulmonary artery on one side was occluded by means of a cardiac catheter with an inflatable balloon at the end. The balloon was inflated with umbradil and could be observed fluoroscopically during filling to prevent overdistention. By this means the circulation in the pulmonary artery on one side and the oxygen uptake in this lung could be stopped. Thereby conditions were created which closely resembled the status following pneumonectomy, so that circulatory and respiratory changes resulting from extirpation of one lung could be foretold. No complications were observed.

By injection of contrast material distal to the occluded artery the pulmonary arteries may be studied in detail.—*T. C. Stansbury, Jr., M. D.*

Andersson, Ture. Electrokymographic studies in pulmonary stenosis and tetralogy of Fallot. *Acta radiol.*, Nov., 1951, *36*, 345–355.

The author has examined 5 cases of pulmonary stenosis, 3 cases of tetralogy of Fallot and 1 case of hypoplasia of the pulmonary artery by electrokymography. In all cases there were characteristic changes. The curves had, in contradistinction to normal ones, a gradually rising course instead of an abrupt steep ascent.

The records from the different cases, however, were not quite uniform. Certain differences were seen to exist in the curves, depending upon the type of pulmonary stenosis. Thus, in the cases with high grade pure pulmonary stenosis and poststenotic dilatation, there was no important degree of expansion of the vessel during systole. The electrokymographic curve from the pulmonary artery showed only a slight ascent.

The curves were sinuous in the tetralogy cases showing moderate infundibular pulmonary stenosis without any poststenotic dilatation.

In 2 cases in which there existed both infundibular and high grade valvular stenosis, both preoperative and postoperative electrokymograms were made. On comparing them, it appeared that the high grade electrokymographic changes seen before operation disappeared in the postoperative curves. (At operation the valvular stenosis but not the infundibular stenosis was alleviated.) The changes in question were accordingly produced by the valvular stenosis. The sinuous curves obtained after surgery probably represented infundibular stenosis.—*Mary Frances Vastine, M.D.*

Moore, B. P. Bronchiectasis with unsuspected foreign body. *Brit. M. J.*, Nov. 24, 1951, *2*, 1259–1260.

Four cases of bronchiectasis in which the examination of the resected lung tissue revealed an unsuspected foreign body are discussed. Three of these cases were operated upon because of severe hemorrhage. Blood stained sputum was a symptom of the fourth case.

It is suggested that any patient with bronchiectasis who gives a history of hemorrhage should be suspected of having a foreign body and that the operative specimen should be thoroughly examined to exclude it.—*J. H. Harris, M.D.*

Weissman, Herman. Lipoid pneumonia; report of two cases. *Am. Rev. Tuberc.*, Nov., 1951, *64*, 572–576.

Lipoid pneumonia is caused by aspiration into the lungs of fatty materials of vegetable, animal, and mainly mineral oil origin.

The reaction produced in pulmonary alveoli has been investigated by Pinkerton who found that sim-

ple neutral vegetable oils caused no tissue reaction in the absence of infection. The animal fats resulted in fibrosis of the alveoli and lymph nodes due to their hydrolytically produced fatty acids. The mineral oils were emulsified and produced slow but inevitable fibrosis. The stages of reaction were: (1) diffuse acute—interstitial proliferative inflammation with or without exudative pneumonia; (2) diffuse chronic—representing the intermediate stage and consisting essentially of a proliferative fibrosis; and (3) chronic localized—representing tumor-like paraffinomas.

The roentgen findings depend on the duration and extent of disease. A common finding is a ground-glass density of the perihilar shadow extending to nearly an inch from the pulmonary periphery and toward the dependent portion of the lungs. There is no hilar lymph adenopathy and no atelectasis or pleural reaction is noted. Serial roentgenograms show little change. History of oil ingestion, examination of sputum, and biopsy may be required for diagnosis.

Of the 2 reported cases, 1 was that of a forty-nine year old man who cleaned oil-dipped machinery with an air blast of considerable pressure. Nebulized oil was inhaled over a period of time. The roentgenograms revealed fibrotic and patchy areas throughout both lungs. The hilar areas were markedly enlarged. There was marked clubbing of the fingers.

The second case was that of a fifty-four year old man who had difficulty in swallowing oily foods and had used mineral oil for a number of years. The roentgenograms of the chest showed irregularly circumscribed patchy densities in the lower halves of both lung fields extending from the hilar areas to within 3 cm. of the outer lung margins.—*E. E. Julien, M.D.*

Buckles, Maurice G., Potts, William L., Davidson, Horace B., and Neptune, Wilford B. Bronchography in pulmonary tuberculosis; with histopathologic correlation in 82 resections. *Am. Rev. Tuberc.*, Oct., 1951, *64*, 394–407.

Prior to major thoracic surgery for active tuberculous lesions, 222 consectuive patients of the Benjamin Franklin Hospital, Columbus, Ohio, were subjected to bronchoscopy and bronchography. One-half the cases were diagnosed as far advanced.

Transglottic instillation of iodized oil after pontocaine topical anesthesia produced no serious complications.

A total of 115 patients were diagnosed as having bronchiectasis. Resections were performed in 81 cases with 82 resected specimens subjected to gross and microscopic examination. There was a nearly 20 per cent error in roentgen diagnosis. Bronchiectasis was predicted in 60 patients preoperatively and substantiated in 44 specimens. The error may be explained by overreading of bronchograms, overlooking borderline cases during pathologic examinations or by confusing oil-filled cavities with bronchiectatic dilations. Distortions due to tuberculous bronchitis may be the principal source of error.

The 44 verified cases of bronchiectasis represented 21 cases without tuberculous bronchitis, 21 cases with endobronchial tuberculosis, and 2 cases which were tuberculous bronchiectasis. There were 14 cases (17 per cent) of tuberculous bronchitis without bronchiectasis.

The importance of bronchography lies in indicating the type and extent of pathology present. A better estimation of prognosis is possible with resection supplanting thoracoplasty in many cases. In the present series no case of bronchiectasis was overlooked by bronchography to be subsequently found in microscopic examination.—*E. E. Julien, M. D.*

Fagin, I. Donald, and Balberor, Harry. Silicosis encountered among automobile workers. *J. Mich. M. Soc.*, Nov., 1951, *50*, 1248–1250.

One hundred cases of silicosis which were detected at a medical diagnostic clinic serving automobile workers in Detroit are reported. Approximately one-half of the patients gave a history of mining exposure. Most of the remainder were foundry workers and a few were grinders, polishers, core makers, a glass maker and also a stone quarry worker. Twenty-nine patients had two or more types of exposure. Over 90 per cent were between the ages of forty and sixty-nine years.

Silicosis may be encountered in various divisions of the auto industry such as foundries, body shops (metal polishing and finishing), machine shops where grinding is done and in the core making departments. In foundry work silica dust may be produced by sand blasting, shake-out processes, molding, grinding and cupola patching. Educational campaigns in the past two decades have helped to eliminate the silica risk by dust trapping, isolation of dust procedures, proper respiratory protection and substitution of non-siliceous materials when possible. However, some of the smaller foundries still remain a potent source of silica exposure for workers.

The authors classify silicosis into three stages: Stage I—diffuse miliary or submiliary nodulation in the lung fields; Stage II—confluent nodulation; and Stage III—massive fibrotic areas and/or very marked coalescent nodulation. They do not make a diagnosis of silicosis unless diffuse miliary or submiliary nodulation is present. Of the 100 cases, 77 were in Stage I, 13 in Stage II and 9 in Stage III. Twenty cases showed the presence of tuberculosis associated with silicosis and 6 of these ultimately became active.

Clinically, 39 patients had no pulmonary symptoms; 36 were dyspneic; cough was present in 23, and chest pain in 15. No physical signs were demon-

strable in 66 cases, rales were present in 27, emphysema in 13 and cyanosis in 2.

It was found quite difficult to estimate the disability in the individual case since determination of the vital capacity and respiratory response to exercise gives only approximate values. The more recent tests, such as maximal oxygen consumption, alveolar and blood gas determinations and bronchospirometry are too complicated for use in plant medical departments. The authors gauge disability on the patient's subjective evaluation of symptoms, physical signs and roentgen findings in the chest.

The conclusion is reached that it is more desirable to eliminate the silica hazard than to remove the silicotic from a job for which he is trained. If this cannot be done, however, the patient should not be further exposed to dangerous concentrations of the dust. Periodic roentgenographic and physical examinations are important for the early recognition of silicosis.—*C. W. Cooley M.D.*

Dahmann, J. Das traumatische Lungenkarzinom; Beitrag zur Pathogenese der Narbenkrebse der Lungen. (Traumatic lung carcinoma; on the pathogenesis of cicatricial lung carcinoma.) *Fortschr. a. d. Geb. d. Röntgenstrahlen ver. m. Röntgenpraxis*, Nov., 1951, *75*, 628–635.

According to Scheid, the following points are prerequisites for accepting a causative relationship between a single trauma and subsequently developing carcinoma:

1. A definitely established trauma with tissue damage.
2. Long lasting regenerative processes.
3. A latent period, often of many years' duration, between trauma and appearance of the carcinoma.
4. The facultative presence of a congenital and of an acquired tumor disposition.

Only few of the published cases of traumatic lung carcinoma fulfill these criteria. A case in which the traumatic etiology seems to have been established is presented in detail, with roentgenographic reproductions and postmortem findings. The pathogenesis is also discussed.

The patient, a male sixty-four years of age, suffered an injury to the right lung from a retained shell fragment in 1918. In 1946, on roentgenograms of the spine taken for back pain, a large metallic fragment was seen in the right hilar region, with a small surrounding area of fibrosis. In the intervening twenty-eight years, the patient had no chest complaints. In early 1950, the patient began complaining of right chest pain, cough with mucoid sputum, anorexia and weight loss. On admission in June, 1950, a large mass was seen surrounding the metallic foreign body in the right hilar region. A diagnosis of carcinoma of the lung was made and roentgen treatments up to a tumor dose of 4,800 r were given, with temporary improvement. The patient died in January, 1951, and the autopsy findings were the following: A carcinoma of the size of a hen's egg, with a central necrotic cavity containing the shell fragment was found. Pleural adhesions were present at the point of entry of the fragment and fibrous strands were found in the neighborhood of the cavity. Histopathological examination revealed a solid, necrotizing, small cell carcinoma of the lung. The pathologist's opinion was that this case probably represented a cicatricial carcinoma, having originated from the scar tissue surrounding the foreign body in the lung.

Four roentgenographic reproductions, a photograph of the autopsy specimen, a microphotograph and an extensive bibliography are contained in the paper. This is a well authenticated case which could be classified from the pathologist's viewpoint with carcinomas originating in old scars after burns, in lupus, etc.—*K. E. Matzinger, M.D.*

Fisher, Martin M., Hochberg, Lew A., and Wilensky, Nathan D. Recurrent thrombophlebitis in obscure malignant tumor of the lung; report of four cases. *J.A.M.A.*, Nov. 24, 1951, *147*, 1213–1216.

Recurrent thrombophlebitis may be the first sign that obscure carcinoma of a visceral organ is present. It occurs particularly in cancer of the lung, pancreas, or stomach. Clinically lesions of superficial thrombophlebitis associated with carcinoma are characterized by thrombosis of the vein with little evidence of inflammatory reaction and they subside in a few days.

The authors present 4 cases of thrombophlebitis antedating primary pulmonary neoplasm, which failed to respond to adequate anticoagulant therapy. Three per cent of the patients had recurrent thrombophlebitis and were considered at one time to have thromboangiitis obliterans.

The first patient was a forty-three year old man who had ten different thromboembolic phenomena including a pulmonary infarction and bilateral foot gangrene. A peripheral adenocarcinoma of the lung, measuring only 1 cm. in its greater diameter, was found at autopsy with metastases to the spine. The thrombophlebitis preceded the localization of the primary focus in the lung by one and one-half months.

The second patient, also a forty-three year old man, developed a thrombophlebitis of the leg following trauma to the extremity. Subsequently he developed thrombophlebitis of the opposite leg, a pulmonary infarct, thrombophlebitis of both upper extremities and then an iliofemoral thrombosis. These preceded recognition of a primary adenocarcinoma of the lung by six months. At autopsy there were metastases to regional lymph nodes, thoracic spine and brain.

The third patient, a man aged forty-two, had recurrent thrombophlebitis with many different bouts

of short duration which subsided spontaneously. The primary tumor of the lung was not identified until four months later. The patient died five months after this.

The fourth patient, a man aged sixty-six, had a diagnosis of carcinoma of the lung made three months after onset of a thrombophlebitis of the right calf. Pneumonectomy was done and the patient was well nine months later with no recurrence of the thrombophlebitis.—*A. B. Smith, M.D.*

Abdomen

Fassio, Étienne. Aspects divers des duodénopathies parasitaires. (Various aspects of parasitic duodenopathies.) *Arch. d. mal. de l'app. digestif*, Nov., 1951, *40*, Suppl., 393–400.

In a certain number of cases parasitic infestation of the digestive system is manifested by epigastric symptoms, mainly due to the involvement of the duodenum. The duodenum is not only affected by inflammatory processes, it also shows functional and allergic disturbances. Duodenopathies should be studied from these three viewpoints.

Pyloric spasm is often the predominant digestive symptom of parasitic infestation, especially in children. It disappears completely following specific treatment while it remains uninfluenced by antispasmodics. The latent spasmodic tendencies of these patients were studied, and a hypocalcemia was found in 3 patients suffering of teniasis. In many cases of *G. lamblia* infestation the duodenum showed marked stasis as a result of increased antiperistaltic movements. In these cases the roentgenograms of the duodenum failed to reveal any increase in the thickness of the duodenal folds.

The presence of parasites in the duodenum may produce an inflammatory process by mechanical irritation mainly, and a superimposed secondary infection. These cause variable but characteristic roentgenological changes. Microscopic examination of duodenal contents shows numerous polymorphonuclear cells, and occasionally the parasite can be demonstrated in the duodenal washing. It is not uncommon for the gallbladder and the pancreas to share in the inflammatory process.

Allergic manifestations in the duodenum have been observed, especially in conjunction with systemic allergic manifestations such as urticaria, eosinophilia, and dermatographia. The allergic manifestations disappeared after the parasites were expelled.

From the therapeutic point of view, the conclusion is reached from these studies that the parasitic factor should not be overlooked in painful syndromes of the epigastrium, and that it is advisable to combine the antiparasitic treatment, with anti-allergic, antispasmodic, and anti-inflammatory treatment.—*Najib Abu-Haydar, M.D.*

Thomas, Sydney F., Henry, George W., and Kaplan, Henry S. Hepatolienography: past, present, and future. *Radiology*, Nov., 1951, *57*, 669–684.

A satisfactory contrast medium for the demonstration of the liver and spleen has not been developed. The possible injurious effects of thorotrast are considered on the basis of a review of the literature and direct communications from 68 radiologists reporting its use on a total of 4,325 individuals. Only 5 instances of malignancy following its use over a twenty year period were reported. Such an incidence was not considered significant. A more serious complication is late fibrosis of the liver and spleen which occurs with sufficient frequency to contraindicate the use of thorotrast as a contrast medium. This effect may be due to the colloidal heavy metal rather than the radiation, *e.g.*, silicosis.

An iodized stearic ester (iodsol) produces satisfactory visualization but deaths from oil embolism have been reported. This type of contrast medium is readily eliminated from the body but toxicity from the iodine must always be considered.

Studies on the use of (1) inorganic non-toxic metallic compounds such as tantalum and (2) iodized oil emulsions stabilized with newly developed wetting agents to prevent oil embolism are in progress.—*M. B. Goodwin, M.D.*

Salembier, Y., and Lepan, R. Injection du canal de Wirsung au cours des cholangiographies; à propos de 18 observations. (Injection of the canal of Wirsung during cholangiography; study of 18 cases.) *Arch. d. mal. de l'app. digestif*, Dec., 1951, *40*, 1371–1376.

The authors report on 18 instances in which the duct of Wirsung was visualized in the course of 90 cases examined. All cholangiograms were made with tenebryl. The duct does not visualize regularly on repetition either in the same patient or during the same examination and does not depend on the amount injected.

A satisfactory result establishes the anatomy of the sphincter of Vater and the relation of the opening of the duct of Wirsung to that of the common duct.

Common duct pressures were not clearly related to the visualization. Three were normal, five low, nine elevated. However, obstruction and pathological states seemed to favor it. There were ten organic and eight functional disturbances. Four of the latter consisted of hypertonus of the sphincter of Oddi.

The authors conclude that there is no reliable evidence that visualization of the duct of Wirsung can be attributed to a new syndrome.—*Marcy L. Sussman, M.D.*

Albot, G., Toulet, J., and Bonnet, G. F. Essais de cholécystographie de face et de

profil. (Lateral and frontal studies in cholecystography.) *Arch. d. mal. de l'app. digestif*, Nov., 1951, *40*, 1187–1192.

Standard cholecystograms are often found to lack in accuracy, and radiomanometry of the gallbladder is too complicated a procedure for routine examination. An intermediary method of study of the shadows of the gallbladder has been devised and found to be satisfactory.

Five roentgenograms are made in the following positions: in the vertical position with compression of the gallbladder area, in the dorsal recumbent position, in the lateral position and in the anteroposterior position before and after a fatty meal.

The vertical position is of definite value in demonstrating small and radiotranslucent stones.

The dorsal recumbent position has been found more useful than the ventral recumbent position, especially in demonstrating the infundibulum and duct of the gallbladder, which are more often the site of the disease.

Lateral roentgenograms show a more detailed picture of the anatomy of the gallbladder and its ducts. They also give more information on the function after the fatty meal; this study is of special importance in bringing out certain functional disturbances, such as atony or hypertony of the viscus.

Independently from this technique, certain pharmacodynamic studies were done. Prostigmine has been found inferior to a fatty meal in inducing emptying of the gallbladder. Intravenous atropine resulted in a greater shadow of the gallbladder rather than a smaller one. The atropine exerts its effect on the musculature of the gallbladder as well as on the sphincter, and results in atony of the greater mass of musculature in the viscus. A similar effect was observed with amyl nitrite.

For comparison of dimensions, a metallic wire mesh of known measurements was placed on the cassette and the surface of projection was computed with accuracy. Normal contraction of the gallbladder reduced the projection surface by 75 per cent in the frontal roentgenograms and 60 per cent in the lateral roentgenograms.—*Najib Abu-Haydar, M.D.*

Gleize-Rambal, M. L. La radiologie fonctionnelle de la vésicule biliare. (Functional roentgenology of the gallbladder.) *Arch. d. mal. de l'app. digestif*, June, 1951, *40*, 788–791.

Priodax (phéniodol, biliselectan) contains phenolpropionic acid as the iodine carrier which is a better hepatotropic component than the phenolphthalein of the tetraiodophenolphthalein and of other gallbladder dyes used in the past.

The author points out the possibilities and advantages of functional study of gallbladder with the more recent contrast media. He stresses the advantages of fluoroscopic examination of a clearly visualized gallbladder. Faradic stimulation of gallbladder is being experimented with under fluoroscopic screen. The author believes that the tonus of the gallbladder can be ascertained better after 5 cc. intravenous injection of dycholium (dehydrocholic acid). An hour after such an injection, if the gallbladder does not show any appreciable increase in size, its tonus is considered normal. If the increase of volume is considerable, hypotonia of the gallbladder is present.

He also thinks that a two hour film, after a fatty meal, is of little or no functional diagnostic value. Thus, the gallbladder volume may appear unchanged because of the enterohepatic cycle (reutilization of the iodine excreted in the bile). Only after a second fatty meal, given two hours after the first, and a four hour film after the first fatty meal, would there be enough change in the volume of the gallbladder to be of any diagnostic value—*J. N. Sarian, M.D.*

Bauer, William B. A. J. Postcholecystectomy complications due to incomplete removal of gallbladder and cystic duct; report of a case of so-called reformed gallbladder. *Arch. Surg.*, Nov., 1951, *63*, 612–616.

The author states there is a high percentage of postoperative recurrence of symptoms of gallbladder disease or of non-improvement of symptoms. A few are explained by achlorhydria following cholecystectomy but these can be controlled by hydrochloric acid. In others, delay in surgery may produce contiguous disease such as pancreatitis or hepatitis and even good surgery may not help. Some, such as hepatic duct stones, choledochal stones and anomalies (double gallbladders) and "reformed gallbladders" from cystic duct remnants, are missed at surgery. This should not occur.

The author believes cholangiography on the operating table offers the best solution toward minimizing postcholecystectomy symptoms.

A case is described in which a gallbladder reformed from the remnant of the cystic duct. Cholecystography made the preoperative diagnosis. The patient, aged forty-four, had a cholecystectomy seven years previously and symptoms of "gas attacks" reappeared five years later.—*A. F. Rossitto, M.D.*

Macarini, N., and Oliva, L. Sur l'insufflation rétropéritonéale associée à la stratigraphie tridimensionelle. (Retroperitoneal insufflation associated with three dimensional laminagraphy.) *J. belge de radiol.*, Sept., 1951, *34*, 281–297.

A survey of the pertinent literature is presented. The advantages of retroperitoneal insufflation in the roentgenological diagnosis of the abdominal organs are discussed. Laminagraphy in three spatial dimensions after retroperitoneal insufflation gives the best visualization of these organs. The authors present ten such laminagrams of convincing interest. The kidneys, suprarenals, liver, spleen and pancreas are the organs which are best demonstrated by this tech-

nique. They stress the transverse axial plane as being the best in rendering a view of the pancreas as a whole.

Their technique is as follows: Using an ordinary injection needle, they introduce it 1 cm. anterior to the lower point of the coccyx along the anococcygeal line. If no liquid nor gas is aspirated, they inject 0.5 cc. of normal saline solution which should produce a slight burning sensation. Then they begin to inject, slowly, from 1,400 to 1,700 cc. of oxygen through the needle, depending on the age and weight of the patient and the region to be examined. The patient is originally in the right lateral decubitus position with knees flexed and the shoulder and the head slightly elevated. After the injection of one-half of the quantity of oxygen (it should take about two to three minutes) the patient is turned to the left to receive a comparable quantity of gas within the same lapse of time. Then, after lying on his back for fifteen minutes, he is made to stand up and laminagrams are taken before and after the removal of the needle. Palpation of crepitation and tympanism in the lumbar fossae are signs of good retroperitoneal insufflation.—*J. N. Sarian, M.D.*

Truc, Marchal, and Paleirac. Le pneumo-exo-péritoine par voie sus-pubienne; nouvelle technique d'insufflation; séméiologie radiologique de l'espace sous-péritonéal abdomino-pelvien. (Exoperitoneal insufflation through the suprapubic space; a new technique of insufflation; roentgen examination of the subperitoneal space of the abdomen and pelvis.) *J. d'urol.*, 1951, *57*, 125–140.

The authors believe that the precoccygeal or retrorectal method of retroperitoneal insufflation has many inconveniences and limitations and at times is impossible to perform. Their technique of injecting air into the suprapubic space (of Retzius) with the help of a pneumothorax apparatus (Kuss') seems to be more practical and has the advantage of not causing any pain to the patient and giving more information about the retroperitoneal organs of the pelvis. Moreover, no complications have been noted but the authors have always taken the precaution of letting the patient lie down the whole day after the injection of air to prevent a rapid diffusion of the air into the mediastinal and retropleural spaces.

The authors use a lumbar puncture needle and fill the bladder before inserting the needle into the suprapubic space. They inject from 2,000 to 3,000 cc. of air very slowly in twenty to thirty minutes.—*J. N. Sarian, M.D.*

Lorber, Stanley H., and Shay, Harry. Afferent loop studies after subtotal gastric resection. *Am. J. M. Sc.*, Nov., 1951, *222* 544–553.

Intestinal complications which result from subtotal gastric resection for peptic ulcer often present difficult diagnostic problems. Distortion of the stomal area may make roentgen examination hard to interpret, and visualization of the afferent (duodenal) loop by routine methods is often incomplete. To delineate more clearly the stomal area and to obtain adequate filling of the afferent loop with barium, the authors have devised a special intubation technique by which a more comprehensive roentgen study can be obtained.

A double lumen Miller-Abbott tube was arranged with a 5 cm. balloon tied over a bucket which fits into the smaller lumen. Holes were made in the larger lumen proximal to the bucket. Under fluoroscopic observation, the tube was introduced into the stomach of the fasting patient and was allowed to pass 3 to 6 inches into the efferent segment of jejunum. The balloon was then slowly inflated with 50 to 100 cc. of air, in order to block the efferent loop. While in the erect position, the subject was given 30 cc. of a barium-water mixture. If the tube was found to be in the efferent segment and if complete obturation of the jejunum was obtained by the balloon, he was then given 240 cc. of a barium meal. Ingestion of the barium meal usually resulted in some filling of the afferent loop. In order to fill the duodenal segment completely, the patient was placed in various positions on the fluoroscopic table.

In some subjects, the first swallow of barium passed through the efferent segment and revealed the tube to be in the afferent loop. In such instances, the balloon was deflated and barium was instilled by syringe through the other lumen of the tube directly into the afferent loop.

Controlled subjects were selected for the study which showed the amount of distortion produced by the surgical procedure. Several abnormal cases are described and illustrated in which diagnoses of stump ulcer, perforation of the duodenal stump (stump leakage), a false pouch at the junction of the afferent and efferent segments, and marginal ulcer were made. Very few technical difficulties were encountered in these studies but the procedure usually requires thirty to sixty minutes. The method is recommended in those subjects in whom disease of the stoma or efferent loop is suspected and cannot be demonstrated by routine methods.—*Paul R. Dirkse, M.D.*

Shaw, R. Cunliffe. Cyst formation in relation to the stomach and œsophagus. *Brit. J. Surg.*, Nov., 1951, *39*, 254–257.

Previously two types of gastric cysts have been described; the first, the single, unilocular large cyst with a wall resembling the normal wall of the stomach but without connection to the stomach. These are usually in the mediastinal esophagus. The other type of cyst is found in the stomach wall, in which there is widespread cyst formation in the mucosal and submucosal layers. These have occasionally been associated with severe gastritis.

The unilocular esophageal gastric cyst is thought

to be congenital in origin and, aggravated by inflammation, becomes larger and causes clinical symptoms.

It has been suggested that the multiple cysts are associated with severe gastritis, erosion of the mucosa, infiltration and swelling of the gland outlets, followed by retention cyst formation.

A case is reported of a rare unilocular cyst occurring in the fundus of the stomach, associated with a chronic peptic ulcer.

It is suggested that this may be of significance in illustrating the factors behind gastric cyst formation. —*G. L. Sackett, Jr., M.D.*

Grime, R. T., and Whitehead, Raymond. Giant hypertrophic gastritis simulating malignant disease. *Brit. J. Surg.*, Nov., 1951, *39*, 244–246.

The authors report a case of this rare condition and review the literature on the 38 cases previously reported.

The disease is characterized by great thickening of the stomach wall over a wide area, in which the rugae resemble cerebral convolutions.

The cause is unknown, and there is no characteristic clinical picture, but malignancy is usually suggested by the symptoms. It may occur in any adult, and seems to be more frequent in males.

There may be associated weight loss, anemia and edema. There is seldom a palpable mass. Hydrochloric acid may be present, or there may be an associated achlorhydria.

Whether or not this condition predisposes to carcinoma of the stomach has not been established, but the general opinion is that it does not.

Diagnosis may be suggested by roentgen examination with a barium meal. The stomach shows large filling defects which are smooth and mobile. The underlying gastric wall remains elastic. Gastroscopic examination will confirm these findings.

Treatment may be either medical or surgical. After prolonged medical treatment, the masses tend to disappear, but there is usually a recurrence following interruption of the therapy. Gastrectomy seems to offer a more rapid and satisfactory cure. At laparotomy the "feel" of the stomach is quite characteristic. With partial gastrectomy the remaining affected mucosa seems to regress spontaneously.

Giant hypertrophic gastritis is a rare condition, often simulating malignancy, that should be considered in the differential diagnosis of diffuse gastric neoplasms. The roentgenologic appearance may suggest the correct diagnosis and thus aid in its proper treatment.—*G. L. Sackett, Jr., M.D.*

Baty, John A. Gastric neurilemmoma. *Brit. J. Surg.*, Nov., 1951, *39*, 251–253.

The author presents a brief discussion of gastric tumors of neurogenic origin, and gives a case report.

The presenting symptom of most of these tumors is hemorrhage, as in the case reported. The patient had had severe hematemesis and collapse but was recovering well under ulcer therapy. She became very much bothered by offensive breath, and subsequent gastric roentgen examination showed a large ulcer crater suggestive of malignancy.

The patient was explored and a fundal mass noted and a gastrectomy done. Despite a stormy postoperative course, the patient recovered.

The tumor was found to be a neurilemmoma (schwannoma) with an ulcerated necrotic center, and not frankly malignant.

This is another type of gastric neoplasm which must be thought of in the differential diagnosis of tumors of the stomach. This could not be established roentgenologically in this case.—*G. L. Sackett, Jr., M.D.*

Hagans, James A., and McCord, Malcolm C. Gastric ulcer; diagnostic studies in 100 cases. *Am. J. Digest. Dis.*, Nov., 1951, *18*, 335–337.

The authors studied 100 cases of gastric ulcer in an effort to distinguish between benign and malignant types. In their series, 86 were considered to be benign and 14 malignant. Forty-nine of the remaining 86 benign ulcers were proved by microscopic examination and the remaining 37 were considered benign by their clinical course. Twelve of the 14 malignant ulcers were proved by microscopic examination and the remaining 2 were malignant as shown by their subsequent course.

Analysis of the patient's history, laboratory, roentgenologic and gastroscopic findings was the basis of the study.

Analysis of the history showed that age was no criterion as there was one case under thirty years that had a malignant gastric ulcer. The duration of symptoms varied and was not diagnostic. Ulcer pain, weight loss and gastrointestinal bleeding occurred in both. Previous roentgen studies of the upper gastrointestinal tract showed the presence of a duodenal ulcer in some and a small number were negative. History of a duodenal ulcer did not rule out the possibility of a malignant gastric ulcer.

Histamine gastric analysis showed that achlorhydria did not exclude a benign gastric ulcer and that normal acidity or hyperchlorhydria did not exclude a malignant gastric ulcer. Approximately the same percentage (20–25 per cent) of cases of benign and malignant gastric ulcers exhibited an anemia and a positive guaiac test on the stools.

Roentgen studies of the upper gastrointestinal tract with barium showed that the size of the ulcer did not aid in the differential diagnosis, as approximately 20 per cent of the benign ulcers were 3 cm. or more in diameter, and 33 per cent of the malignant ulcers were more than 3 cm. in diameter. The presence of a duodenal ulcer or scarring of the duodenum was no proof that the associated gastric ulcer was benign as 2 of the 14 malignant gastric ulcer cases

had deformity of the duodenal bulb. The location of the gastric ulcer was no indication as to malignancy. The roentgen appearance of the gastric ulcer was likewise not always reliable as 3 of 9 malignant ulcers were thought to be benign.

Gastroscopy was not dependable as not all of the ulcers could be visualized and the ulceration appeared either benign or malignant.

The authors conclude that none of the above studies were entirely reliable in differentiating between benign and malignant ulcer. Surgical resection or, more conservatively, a trial of strict medical treatment followed by repeated studies and then surgery in those patients who respond poorly, is thought to be the best procedure to meet the problem.—*C. W. Cooley, M.D.*

Swynnerton, B. F., and Truelove, S. C. Simple gastric ulcer and carcinoma. *Brit. M. J.*, Nov. 24, 1951, *2*, 1243–1246.

In making a survey of 375 patients treated in Radcliffe Infirmary, Oxford, for gastric carcinoma, 26 patients were found who showed some evidence that the neoplasm might have originated in a chronic gastric ulcer. Each of these cases is described in relation to their clinical history, roentgen findings, operation, autopsy and microscopic findings.

There was good clinical evidence of chronic simple ulcer in only half of the patients. The site of the neoplasm conformed with the distribution of carcinoma of the stomach and in 3 cases the carcinoma had arisen at a site different from that of the pre-existing simple ulcer.

The authors believe that most of the above cases are examples of ulcerating carcinoma, and since the majority were prepyloric, and prepyloric ulcers should be considered malignant, surgery is indicated. —*F. B. Markunas, M.D.*

Sullivan, James M., and Hamman, Louis. Internal biliary fistula due to peptic ulcer. *Arch. Surg.*, Nov., 1951, *63*, 635–640.

Spontaneous internal biliary fistula represents 3 to 5 per cent of all biliary disease. It is caused by neglected cholelithiasis (90 per cent), peptic ulcer (6 per cent), and carcinoma (4 per cent).

Once established, the fistula usually intensifies the symptoms of gallbladder disease and remains open until the cause is removed. Occasionally the acute cholecystitis symptoms are dramatically relieved by the fistula.

Roentgenographic visualization of air or barium sulfate in the biliary system can establish the diagnosis.

The authors present 2 cases of biliary fistula caused by perforated duodenal and gastric ulcers, both diagnosed roentgenologically. Roentgenograms and sketches reveal the pertinent findings.—*A. F. Rossitto, M.D.*

Morgan, Russell H. Peptic ulcer in children. *Am. J. M. Sc.*, Nov., 1951, *222*, 590–600.

A review of the recent literature on this subject indicates that the incidence of peptic ulcers in children is much higher than is generally believed. The peptic ulcers in infancy are usually acute with the onset of symptoms often precipitous. Most of these either bleed profusely or perforate. As the age of the child increases, the type of the ulcer increases in chronicity. The incidence of bleeding and perforation diminishes. The symptoms are more likely to be of the adult type.

As in adults, the pathogenesis of peptic ulcer in childhood is poorly understood. Various theories concerning the etiology are discussed in some detail. It seems reasonable to believe that there must be some physiological or structural characteristic in the ulcer-bearing area of the stomach and duodenum that plays a deciding role in ulcer formation. A neurogenic explanation is plausible for the various types of ulceration found in childhood. However, it is still difficult to explain the differences in the symptom complexes of childhood and adult peptic ulcers.

Roentgenologic diagnosis. The technique of examination is similar to that used in adults. However, it is frequently more difficult to perform because the cooperation of the patient is not easy to obtain; and, second, because pyloric stenosis is often present. It is essential that the basic technical criteria which have been established by Templeton should be fulfilled in every examination if ulceration is consistently to be discovered when it is present. These include the careful fluoroscopic observation of the stomach and duodenum, with the exposure of a sufficient number of spot films to obtain filled views and mucosal relief views of every portion of the stomach and duodenum. Spot films of the duodenum are particularly important. The following procedure is probably the best that has been devised. The patient is first examined erect. A mouthful of barium sulfate suspension in water is swallowed with the usual fluoroscopy. Patient is then tilted to the horizontal position and turned into the right anterior oblique position filling the cardiac end of the stomach with barium and showing the lower portion of the stomach in mucosal relief. Spot film is made at this time. Patient is then placed face down in left posterior oblique position and further fluoroscopy done with additional swallowing of the opaque mixture. Examination is then continued with the patient in the erect position. A spot film is made showing the lower half of the stomach filled and the mucosal pattern in the upper half of the stomach. Patient now swallows the remainder of the 6 ounces of the opaque mixture and an attempt is made to fill the duodenal bulb, which is often quite difficult. If this cannot be filled upright, the patient is again placed in the horizontal position, face down, left posterior oblique. The bulb will usually fill by gravity in this position.

Ulceration of the stomach or duodenum in children

is usually manifested by the presence of a crater in the affected structure. This may be seen and roentgenographed in profile or enface view. With careful execution of this technique a considerably larger number of duodenal ulcers may be discovered.

Treatment of peptic ulcer in children may lead to diminution of the disease in adults.—*Paul R. Dirkse, M.D.*

Hodges, Fred J., and MacMillan, Howard C. Important clinical dividends from x-ray examination of the colon. *J.A.M.A.*, Nov. 24, 1951, *147*, 1191–1194.

A thorough well conducted roentgen examination of the large intestine represents a major diagnostic procedure in terms of technical and professional effort. In the five years from 1944 to 1949 at the University of Michigan 15,350 colon examinations were done by the Department of Roentgenology, with 71.7 per cent of these examinations showing no evidence of organic disease.

Roentgenologically demonstrable abnormalities of the large intestine were found in 4,291 patients. A total of 1,663 patients had one or more miscellaneous abnormalities including postoperative alterations of the colon, fistulous tracts, megacolon, developmental anomaly, displacement by extrinsic masses, hernia involving the colon, volvulus, endometriosis, foreign bodies.

Pathological entities encountered were diverticulosis in 1,477 patients, colitis in 238 patients, primary neoplasm of the colon in 575 patients. In a one year period, from 1947 to 1948, a detailed analysis was made of 102 patients found to have primary neoplasm of the large intestine.

The most common initial symptoms were change in bowel habit (48 per cent), blood in stool (43 per cent), abdominal pain (20 per cent), occurring singly or in combination. On the average, patients waited three months after initial symptoms before consulting a physician.

Profuse bleeding through the rectum, ribbon stools and alternating constipation and diarrhea were due to sigmoid and rectal lesions in 90 per cent of patients.

Sigmoidoscopic examination detected the lesion in 68.6 per cent of the total group and rectal examination in 58 per cent of the total group. A palpable abdominal mass was found in 21 patients and 16 of these were dead two years later.

Of the malignant lesions, 81.3 per cent were in the rectum and sigmoid. Of all primary neoplasms of the colon the radiologist may take full credit for apprehension of one-third. The lesions were detected 85 per cent of the time on the initial examination. A total of 14 per cent of the patients required reexamination to establish the diagnosis. Air contrast technique was used in 75 per cent of the 102 patients.

Ninety of these 102 patients were subjected to operation. Only 29 could be successfully handled. Of the entire patient group, 60 per cent were dead two years after the close of the period under study.—*A. B. Smith, M.D.*

Safran, Nathaniel, and Greenberg, Avrom M. Congenital obstruction of the transverse colon. *Radiology*, Nov., 1951, *57*, 738–740.

This is a case report of an apparent deformity of the transverse colon in a twelve year old girl who had had one attack of abdominal pain, nausea and vomiting one year prior to the present illness. At the latter time there was abdominal pain and constipation for five days. There were no other symptoms. Roentgen examination of the colon showed an atypical defect in the transverse colon which could not be reproduced a few days later.

At surgical exploration there was a congenital fold of peritoneum running from the aorta to the colon. Resection of the fold at its colonic attachment relieved the pressure on the colon and the patient has now been asymptomatic for four years.—*C. A. Stevenson, M.D.*

Belle, Martin S., Fox, Sidney, and Allen, Ralph. Nonspecific granuloma of rectum and sigmoid colon; lesions of rectum and sigmoid colon which clinically simulated cancer but which responded to aureomycin therapy. *Arch. Int. Med.*, Nov., 1951, *88*, 685–691.

The differential diagnosis of benign granulomatous lesions of the rectum and sigmoid includes lymphogranuloma venereum, syphilis, tuberculosis, amebiasis, gonorrhea, and schistosomiasis. At times, the differential diagnosis between a benign granulomatous lesion and carcinoma may be difficult.

The authors report 2 illustrative cases believed to be the first so reported. Both were male Negro patients, twenty-four and twenty-six years old respectively, with the chief complaint of increasing constipation, red blood in the stools and on the examining finger, as well as narrowing of the stools. On proctosigmoidoscopy, the lesions were considered malignant. Roentgen studies revealed the presence of a filling defect and narrowing of the rectum and rectosigmoid area. Following biopsy, however, the lesions proved to be nonspecific granulomas. Other laboratory studies were non-contributory. These lesions disappeared completely following aureomycin therapy (total dosage of 117 and 113 grams respectively) as demonstrated by follow-up proctoscopy and roentgen studies. Both patients were thus spared resection of the colon and rectum at the site of the lesions.

Reproductions of roentgenograms of both cases are presented.—*W. H. Shehadi, M.D.*

Gynecology and Obstetrics

Hodges, Paul C., and Nichols, Russell L. Pelvic dimensions in eutocia and dystocia. *Radiology*, Nov., 1951, *57*, 661–668.

The authors studied pelvic dimensions as revealed by roentgenograms of 912 primiparous white women. Their findings were correlated with the clinical course of the pregnancy.

The following dimensions were used in studying the pelvic inlet: (a) anteroposterior diameter of inlet; (b) transverse diameter of inlet; (c) product index of inlet (a×b). These two measurements and one index were also determined for the mid-pelvis and outlet making, in all, six diameters and three indices, upon which the authors based their studies. Their data are presented in tabular form.

Of the several measurements and indices used, the authors consider the three indices to be the best guide to the dimensional adequacy of the maternal pelvis.

From their data, the authors conclude that there is such an entity as dystocia due to small or deformed pelvic bones. Such bony abnormality can be best determined by safe roentgenological procedures. However, a roentgenologically adequate pelvis does not indicate that there will be no difficulty at delivery. Instead, such data should be used by the clinician as an aid in making proper decisions as to the conduct of the pregnancy and delivery.—*McClure Wilson, M.D.*

González-Martínez, I., and Casanova Díaz, J. A rare case of epidermoid carcinoma of the cervix uteri with late metastases to the respiratory and digestive systems. *Rev. Liga puertorriq. contra el cáncer*, June, 1951, *11*, 97–115.

This is a case report of an epidermoid carcinoma of the cervix treated three years before admission by radium and roentgen therapy. Examination showed no evidence of local recurrence or pelvic involvement. There was an upper abdominal mass 8 by 10 cm. in size. Roentgenograms of the chest revealed two large masses in the right lung posteriorly. Although invasion through lymphatic channels usually occurs in the direction of current it may also be retrograde, when the conditions of normal circulation have been obliterated. The method and location of spread are reviewed by excerpts from various articles and books.

The transverse colon and the mass, which was located in the omentum and invaded the serosa of the colon, were resected and the pathological report was that of anaplastic squamous cell carcinoma, metastatic. The patient died two months later.—*Martha Mottram, M.D.*

Gilliam, Alexander G. Fertility and cancer of the breast and of the uterine cervix; comparisons between rates of pregnancy in women with cancer at these and other sites. *J. Nat. Cancer Inst.*, Oct., 1951, *12*, 287–304.

It is generally regarded as an established fact that marraige, or events such as childbearing which are incident to it, reduces a woman's chance of developing cancer of the breast and increases her risk of cancer of the uterine cervix.

Studies show that large series of breast-cancer cases contain a higher proportion, and cervical-cancer series a lower proportion of single women than observed in the general population; and second, that fertility is reduced in women with cancer of the breast, and either normal or slightly excessive in cervical-cancer patients but with pregnancy occurring at earlier ages among the latter.

Statistics in this article have been compiled by physicians associated with the National Cancer Institute. Patients interviewed were from New York, New Orleans, and Missouri. There is a thorough discussion of the procedures of analysis and possibilities for erroneous conclusions. There are six tables giving detail of the calculations. The results are separated into groups of non-Jewish white, Negro, and Jewish white for comparison.

The details are too extensive to be covered in an abstract and anyone interested particularly in this subject is urged to read the article. However, in general, the conclusions are much as have been shown previously and are consistent with the hypothesis that childbearing of some degree is etiologically related to cancer of the cervix, and that reduced fertility is similarly related to cancer of the breast. The somewhat low fertility observed in patients with other genital cancer and the excessive rate in skin cancer patients has not been noted previously. The same is true of the observation that the illegitimate pregnancy rate in non-Jewish white patients with cancer of the cervix, computed on the basis of unmarried childbearing years at risk, was found to be slightly higher than observed in the breast-and-skin-cancer patients. There is no evidence that cervical-cancer patients experienced an undue proportion of instrumental deliveries.—*I. Earl Holmes, M.D.*

Rosa, Pierre. Étude de la circulation du liquide amniotique humain. (Study of the circulation of the human amniotic fluid.) *Gynéc. et obst.*, 1951, *50*, 463–476.

By injecting 100 cc. of 50 per cent ombradyl (contrast medium similar to diodrast) into the amniotic cavity, studies have been made without any untoward reaction on the part of the mother and of the fetus. It has thus been calculated that within twenty-four hours a fetus, near term, swallows about 500 cc. of amniotic fluid. Of this quantity 40 cc. is excreted through the fetal kidneys, 25 cc. is utilized in the fetal tissues and most of the rest is evacuated through the placenta to the maternal blood stream. A certain quantity of amniotic fluid of undetermined im-

portance is most probably reabsorbed by the amniotic epithelium.

Two to five hours are necessary after the transabdominal injection to visualize the fetal intestines and twelve hours to visualize the maternal urinary tract. The sum of the transplacental and transamniotic elimination of amniotic fluid is compensated to an exact degree by the secretion of the amniotic epithelium.

These quantitative studies have been made possible by the transabdominal injection of inulin in determining the total volume of the amniotic fluid. The author thinks that other substances such as sodium hyposulfite, sodium thiocyanate, para-aminohippuric acid and caronamide used in such studies will be of promising value.—*J. N. Sarian, M.D.*

Genitourinary System

Anderson, J. C. Abnormal function of the upper urinary tract. *Proc. Roy. Soc. Med.*, Nov., 1951, *44*, 925–933.

The author believes there is physiological discontinuity at various levels of the upper urinary tract. This occurs between the calyces and renal pelvis, between the renal pelvis and the ureter, and between the ureter and the bladder. Physiological imbalance at these levels may cause stasis and dilatation of the calyces, renal pelvis and ureter. This physiological division of the upper urinary tract is considered to primarily represent a defensive mechanism, and to be a source of trouble only when it becomes deranged.

When there is a plentiful, steady excretion of urine, peristaltic waves are rhythmically transmitted through the entire upper urinary tract from calyx to ureterovesical junction. When there is deficient excretion of urine, or upper tract obstruction, the lower ureter does not contract due to quantitative deficiency of urine. Sufficient urine must be in the ureter to stimulate a contraction. If there is partial obstruction at the ureteropelvic junction only one or perhaps two to three pelvic contractions are transmitted to the ureter. If the obstruction is removed and the fluid allowed to escape, the ureter is stimulated and the contractions of the pelvis and ureter are numerically equal, *i.e.*, 1 to 1 ratio. A small quanity of fluid is a very effective stimulant. Large quantities of fluid may impede or arrest peristalsis.

Pituitrin and acetylcholine cause the ureter and pelvis to contract. Curare has a blocking effect on subsequent administration of acetylcholine, but otherwise causes little or no effect upon ureteric activity.

Retrograde peristalsis has been observed following mechanical stimulation of the ureter and injection of pituitrin.

The term ureteric spindle may be applied to a dilatation of the upper urinary tract which ends in a spindle at the rim of pelvis where the ureter crosses the common iliac vessel. In 5 such cases, peristaltic waves were seen to be transmitted through the spindle and down the ureter. Four women showed enlarged ovarian veins and a man showed obstruction by a fascia sheet.

A single case of functionless right kidney is presented. Surgically it was shown that there was a complete rotation of the ureter on its long axis. This was considered to be the initiating factor of failure of renal function on the affected side.—*D. R. Bernhardt, M.D.*

Alken, C. E. La rénovasographie per-opératoire. (Peroperative renovasography) *J. d'urol.*, 1951, *57*, 623–629.

The method, which was described in *Ztschr. f. Urol.*, 1950, *43*, 9–10, is applied to the exposed kidney. The renal artery is injected during operation and roentgenograms made with the cassette under the kidney as for calculus. The finest branches of the renal artery are visualized.

In aortography, no thrombosis of the renal artery or dysfunction of the kidney has been reported but an occasional instance of albuminuria, hematuria and cylindruria has been observed. No lesion has been found following renovasography and it is to be noted that all early cases were followed by heminephrectomy.

Various physiologic experiments have been performed. A practical application is the demonstration of the vascular supply to the diseased area before proceeding with heminephrectomy, Certain tumors and cysts are better evaluated if there is doubt after gross inspection of the kidney.—*Marcy L. Sussman, M.D.*

Ney, Charles. Normal intravenous pyelograms in the presence of hydronephrosis; false impressions derived from the use of the intravenous method in neurogenic bladders. *Urol. & Cutan. Rev.*, Nov., 1951, *55*, 667–670.

The author presents 2 case reports in detail in which the patients had spinal cord disease, one of a post-influenzal nature and the other in a child with spina bifida and a soft tissue mass over the sacrum. In both instances, the excretory urograms showed essentially normal upper urinary tracts, but on attempted cystography there was reflux up the ureters. In Case I the reflux was on the right side, and in Case II it was bilateral. In neither case was the hydroureter or hydronephrosis of severe degree.

The normal intravenous pyelogram in such cases is difficult to explain. According to the author, it would appear that the kidney function is unimpaired and that the calyces and pelvis of the kidneys have adequate elasticity to permit accommodation of the small amount of contrast medium present when using the intravenous method.—*G. W. Chamberlin, M.D.*

Ritter, J. Sydney, and Shehadi, William H. Pneumopyelography. *Urol. & Cutan. Rev.*, Nov., 1951, *55*, 649–652.

This article re-emphasizes the use of a nonopaque medium, such as air, for demonstration of soft tissue lesions and nonopaque calculi in the upper urinary tract. The authors have utilized the small ureteral catheter bag which permits complete blockage of the ureter so that adequate air contrast studies can be made. Examples consist of 3 case reports in which nonopaque stones are not demonstrated by the customary methods of urography. It is pointed out that air is nonirritating, easy to administer, and when properly used is without danger to the patient. —*G. W. Chamberlin, M.D.*

Abeshouse, Benjamin S. Diverticula of the anterior urethra in the male; report of four cases and review of the literature. *Urol. & Cutan. Rev.*, Nov., 1951, *55*, 690–707.

This is a thorough discussion of the subject of diverticula of the urethra. Diverticulum of the anterior urethra of the male is a relatively rare lesion. Ninety-four cases of congenital and 130 cases of acquired diverticula, including the cases presented in this article, have been reported up to the present time. Congenital diverticula are usually found in the penile portion of the anterior urethra, whereas the acquired diverticula are more common in the bulbous portion. The former type is due to an arrest in development of the urethra or a faulty development of the urethra. The acquired type is caused by urethral obstruction, perforation, injury, or neurogenic dysfunction. The two types of diverticula differ structurally in that in the congenital type all of the normal layers of the urethra are present, whereas in the acquired type there are thick fibrous walls with a modified epithelial lining. Infection may alter the appearance of a congenital diverticulum to that resembling the acquired type. Complications of diverticula of the anterior urethra include infection anywhere in the urinary tract, stone formation, perforation and other congenital anomalies of the genitourinary tract. The symptoms will depend upon the degree of obstruction or the complications. The most common physical sign is the presence of a soft fluctuant tumor on the ventral surface of the penis. Confirmation of the diagnosis may be obtained by urethroscopy and urethrography.

In the differential diagnosis the author includes enuresis, hydrocele, scrotal hernia, retention cysts of accessory urethral glands or Cowper's glands, and periurethral abscess.

Palliative and non-surgical procedures are carried out for the small diverticula which are asymptomatic. The best results are obtained by surgical treatment. Surgery includes excision or repair of the urethral defect and removal of any obstructing lesions which may be present.—*G. W. Chamberlin, M.D.*

Molineus, W. Induratio penis plastica; ein Bericht über 302 Fälle. (Induratio penis plastica; a report of 302 cases.) *Fortschr. a. d. Geb. d. Röntgenstrahlen ver. m. Röntgenpraxis*, Nov., 1951, *75*, 584–607.

This paper is based on the analysis of 302 cases of Peyronie's disease treated in the Radiation Institute of the University of Hamburg from 1931 to October, 1949. The youngest patient was twenty and the oldest seventy-two years old; 46 per cent of the cases occurred in the sixth decade. The symptomatology and course of induratio penis plastica are briefly discussed. In the beginning radium molds were used; on two successive days a total dose of 800–900 r was administered. Later roentgen rays were given preference because the protection of the testicle is simpler and definitely safe, especially with the author's technique: 60 kv., 4 ma., 5 cm. rubber filter; 2×400 r on two successive days.

In the statistical evaluation of the end results, the number of patients treated incompletely (37) and those treated first elsewhere (42) were deducted; this left a net of 223. In 27 the results were very good (12.1 per cent), in 104 good (46.7 per cent), in 46 fair (20.6 per cent) and in 46 the results were poor (26.6 per cent). The corresponding percentages for the 42 cases treated previously elsewhere were 4 (10 per cent), 14 (34 per cent), 11 (27 per cent) and 12 (29 per cent). One could not be evaluated. In 11 per cent of the author's series telangiectasia developed, usually several years after the last treatment; in a few instances mild atrophy of the skin and pigmentation were seen. In a two page table the author collected data regarding the treatment methods used by 51 authors as published in the literature between 1912–1950; 22 used roentgen rays, 23 radium, and 6 both. —*E. A. Pohle, M.D.*

Skeletal System

Belton, A. A., and Davies, F. Supraglenoidal pseudarthrosis. *J. Bone & Joint Surg.*, Nov., 1951, *33-B*, 629–633.

The rarest dislocation of the shoulder is the supraglenoidal. The patient, whose case is reported, was an eighty-seven year old man who developed, during the last seventeen years of life, osteoarthritis with pain and weakness in the hips, knees, wrists and less frequently in the elbows. Although he had suffered pain in both shoulders there was no weakness or disability and gross derangement was not suspected.

As the conditions were virtually the same in both shoulder joints, the right joint is described in detail with a note of minor differences in the left. An anteroposterior roentgenogram of the dissecting room specimen is shown and the anatomical findings are given in detail, with photographs and drawings of the specimen.

Causes of the condition are discussed, including the possible result of congenital anomaly, and also the

effect of repeated trauma. An interesting finding was the position of the humerus which was elevated above normal and was in contact with concave, polished, marble-like facets on the lower hard surfaces of plaques in the deltoid and with similar facets raised from the lower surfaces of the clavicle and acromial process of the scapula. Histopathological examination revealed that the plaques were composed of bone with dense free surfaces which, in the elevated position of the humerus, apparently pressed and rubbed against the acromioclavicular arch and the deltoid and induced the formation of the eburnated facets.) *R. S. Bromer, M.D.*

Gauwerky, F. Traumatische Deformierungen am Humeruskopf als Folge von Schulterluxationen. (Traumatic deformities of the head of the humerus following dislocations of the shoulder joint.) *Fortschr. a.d. Geb. d. Röntgenstrahlen ver. m. Röntgenpraxis*, Nov., 1951, *75*, 607–627.

The first reference to a defect of the head of the humerus in recurrent dislocation of the shoulder joint is found in Curling's paper published in 1837. Malgaigne's treatise on fractures and dislocations, published in 1850 and 1856, contains drawings showing the defect.

The author was able to show the typical defect in all 20 cases of recurrent dislocation and in 60 of 77 cases of traumatic anterior dislocation of the shoulder occurring for the first time. In 4 cases of posterior dislocation, the defect was found on the anterior surface of the head of the humerus.

The following roentgenographic technique was used: The patient was fluoroscoped and spot films taken in three positions: a straight posteroanterior film; a film with 30°–40° abduction of the humerus and with a degree of internal rotation determined on fluoroscopy to show the defect, located above the greater tuberosity; a film with the humerus elevated vertically and with appropriate rotation of the patient, as determined on fluoroscopy.

Experiments on autopsy specimens showed that a weight of 1 kg. falling from a height of 1.5–2.4 meters produced a similar defect on the head of the humerus. Contraction of the muscles of the shoulder region, pressing the head of the dislocated humerus against the rim of the glenoid, is apparently capable of producing energy of similar magnitude.

The paper contains numerous reproductions of roentgenograms, line drawings and many references. —*K. E. Matzinger, M.D.*

Lübker, Heinz. Die Röntgen-Spezialaufnahmen des Lumbosakralgebietes. (Special roentgenographic techniques for the lumbosacral region.) *Röntgen-Blätter*, Nov., 1951, *4*, 309–314.

The author considers that the routine roentgenograms made in the anteroposterior and lateral supine projections are valuable only as a survey of the lumbosacral spine and that many cases require special roentgenograms for complete diagnosis.

Roentgenograms with the patient standing are indicated in all cases in which the relative position of vertebral bodies with weight bearing is important. In scoliosis, torsion, increased and decreased lordosis, and oblique pelvis, the important changes are not seen on roentgenograms made with the patient in the lying position. This is often due to the attempt of the technician to have the patient "lie straight" for the exposure, thus diminishing the degree of abnormality from normal or masking the abnormality completely.

Several special techniques may be helpful in the roentgen study of the lower spine: (1) anteroposterior supine view of the lumbosacral joint with the tube angled cranially, the degree of angulation depending on the relative lordosis; (2) Ditmar's view in which the supine patient is obliqued 30 degrees and the tube angled 12 degrees cranially. The feet are in the "running" position. A good view of the minor intervertebral joints is thus obtained; (3) Kovács' so-called "cleft film" brings the sacroiliac joints into free projection. The patient is supine and the side to be investigated is elevated about 15–20 degrees and the tube tilted 12 degrees cranially; (4) for demonstration of the neural arches and pedicles, the sitting patient is bent backwards 45 degrees and the central ray directed vertically, perpendicular to the table.

These special roentgenographic views are illustrated.—*Harold Fulton, M.D.*

Moreton, Robert D., and Ehni, George. Radiographic findings in protruded cervical discs. *South. M. J.*, July, 1951, *44*, 582–588.

The authors present an analysis of 18 consecutive patients operated upon for cervical discs. Preliminary roentgenographic studies of the cervical spine in these patients demonstrated either abnormal curvature, interspace narrowing, interspace osteoarthritis, cervical gibbus, or combinations of several of these lesions. In many instances the findings were localized to a single interspace and the lesion affecting the nerve root was found at the affected level.

Myelograms were taken on 16 of the 18 patients and in all instances the pathological lesion was correctly indicated.

Five types of deformities produced by lateral disc protrusion were observed: (1) The appearance of broadening of the root bundle shadow within the root sleeve, which occurs when the root is flattened by compression from beneath. (2) Medial displacement of the root and sleeve shadow complex so that all the root complexes on one side do not appear in a straight line. (3) Superior displacement of a root and sleeve shadow complex so that the space between these shadows is not equidistant due to the presence of a prominence of disc origin below the root, causing it to be displaced in a cephalad direction. (4) Exag-

geration of the normal transverse radiolucency over a disc. (5) Obliteration of the entire root and sleeve shadow complex with more or less indentation of the parent oil column.

In this group of cases, broadening of the root bundle was seen 5 times; medial displacement of the root bundle 3 times; superior displacement of the root complex twice; and the root shadow complex was totally obliterated with more or less identation of the oil column 7 times. Thus, in only about one-half of the patients was the myelographic abnormality of the obvious type usually associated with extradural lesions.

The article contains an excellent drawing of the various types of deformity described and there are seven roentgenographic reproductions illustrating some of the changes.—*James G. Snead, M.D.*

Lindblom, Knut. Backache and its relation to ruptures of the intravertebral disks. *Radiology*, Nov., 1951, *57*, 710–719.

A technique for direct injection of an intervertebral disc is described based on the author's experimental work on human anatomical specimens and living animals. Later the technique was applied to living patients with no apparent bad results. A small needle (0.5 mm. outside diameter) is inserted into the posterior surface of the intervertebral disc and 0.5 cc. of diodrast with a small amount of novocaine is injected. The normal disc will accept this amount of fluid with only slight low back pain. In cases of rupture of the disc the entry of the needle produces fairly severe pain.

Roentgenograms taken immediately after the injection show a bilobed opaque area above and below the nucleus pulposus. In case of rupture, the opaque medium will run posteriorly from one of these bilobed areas and in the more advanced cases the medium may be seen to extend into the spinal canal.

In all cases of disc puncture where rupture was present it was possible to reproduce the patient's pain and from this the author concludes that low back and sciatic pain is most commonly caused by disc rupture. Of interest is the fact that microscopic examination of the distal portion of the prolapsed disc showed granulomatous tissue and sclerosis of the various tissues about the prolapsed disc. It is believed that this inflammatory process, rather than pressure, is the cause of pain.

The author has shown that fixation of a joint leads to degeneration of the intervertebral disc and possible rupture. He believes that the wearing of shoes leads to posterior compression of the discs and that modern man suffers more from prolapsed discs than did prehistoric man. The author then states, "Osteophytes on the vertebral margins almost never occur without disk rupture" and goes on from there to state that in modern man hypertrophic spurs are common at L-5 while pre-historic skeletons showed these changes mainly in the mid-lumbar area.

He concludes, therefore, that some factor in our modern living increases the tendency of intervertebral discs to rupture.—*C. A. Stevenson, M.D.*

Dobson, J. Tuberculosis of the spine; an analysis of the results of conservative treatment and of the factors influencing the prognosis. *J. Bone & Joint Surg.*, Nov., 1951, *33-B*, 517–531.

Tuberculosis of the spine, the author states, is the most common and the most dangerous of all forms of skeletal tuberculosis. The harmful effects of prolonged recumbency, especially in adults, are well known, and there is a growing tendency towards early operation.

In this paper 914 cases are analyzed and the late results ascertained three or more years after discharge from hospital. The relative frequency with which the various segments of the spine are involved was found to be the cervical region in 3.5 per cent of cases, the thoracic in 43.1 per cent, lumbar in 32.9 per cent, thoracicolumbar in 16.7 per cent and lumbosacral in 3.8 per cent.

An attempt was made to ascertain the site of the primary focus in the bone from a careful study of roentgenograms. In children, the characteristic early roentgenographic changes were irregularity of the anterior edges or corners of one or more vertebral bodies followed by wedging and disappearance of the intervertebral disc. In the adult, especially in disease of the lumbar spine, the earliest roentgenographic changes were frequently confined to narrowing of the intervertebral disc and slight irregularity of the adjacent vertebral borders. In the series, these early so-called "epiphyseal" changes were present in 302 cases, or 33 per cent. This point is emphasized by the author because, he states, there is a tendency among some surgeons to assume that almost the only cause of backache in a young adult is a prolapse of an intervertebral disc. The central focus, in which the disease originates in the spongy tissue of a vertebral body is relatively uncommon even in children and was present in only 106 cases (11.6 per cent). Disease originating beneath the anterior common ligament was found in only 19 cases (2.1 per cent), and the neural arches or their appendages were the site of the primary infection in only 4 cases (0.5 per cent). In 483 cases (52.8 per cent) widespread destruction had occurred when the patient was first seen and it was impossible to determine with any degree of accuracy the site of the primary bone focus. In the series, progressive destruction was seen in 35 per cent of children under the age of ten years, and this resulted in gross deformity in later life. There was sometimes frequent spread of the disease from one or two vertebrae to rapid involvement until large segments of the spine were involved. Some of these cases may be due to small osseous foci, invisible in early roentgenograms, in the bodies of the vertebrae above or below the more obviously involved and extensively destroyed areas.

Three complications of outstanding importance are: other foci of active tuberculosis in the body, abscesses and secondarily infected sinuses, and paraplegia. The latter is the most serious complication. Toxemia and amyloid disease accounted for a large number of the deaths in the series. Meningitis was a surprisingly infrequent cause, much less frequent than in cases of tuberculosis of the hip joint. It was found that in 27.3 per cent of cases, spontaneous bony fusion of the affected vertebral bodies occurred.

In paraplegia, Dobson believes, the prognosis is much worse. There is no justification for continuation of prolonged conservative immobilization, which even now is regarded as correct. Early surgical intervention is strongly urged when there is evidence of increasing damage to the spinal cord.—*R. S. Bromer, M.D.*

Paus, Bernhard. Traumatic dislocations of the hip; late results in 76 cases. *Acta orthop. Scandinav.*, 1951, *21*, 99–112.

There are two types of traumatic dislocations of the hip: (1) central, in which the head of the femur is driven in towards the pelvic cavity through the fractured acetabular floor, and (2) noncentral in which the head is forced out over the acetabular edge.

The author reviews the methods of after-treatment which vary from only two days up to several months as quoted in the literature. The present report is based on the follow-up of patients treated in the period 1920–1946. There were 69 patients with 70 dislocations (1 patient dislocated the same hip twice in nine months).

The patients were divided into three groups: (a) symptom free, (b) almost symptom free, and (c) those showing symptoms. Of the 66 surviving cases at the time of the follow-up study, 60 were fully followed up as to subjective, objective and roentgenographic findings (Table 1). The average time of follow-up was fifteen years from injury and all cases were observed for more than three years.

Table I

	Followed up	Symptoms		Symptom free	Completely + almost symptom free
Subjective	66	6	9%	60	(44+16)
Objective	61	7	11½%	54	(49+ 5)
Roentgenological	60	16	26½%	44	(26+18)
Subjective and/or roentgenological	60	17	28%	43	(18+25)

The sequelae which have been observed were:

Pain	in 4 of 66 cases
Feeling of stiffness	in 3 of 66 cases
Restricted mobility	in 6 of 61 cases
Limping	in 2 of 61 cases
Persistent dislocation	in 1 of 61 cases
Calcification in the soft tissues	in 22 of 60 cases
—but significant only	in 9 of 60 cases
Hypertrophic arthritis	in 12 of 60 cases
Necrosis of the femoral head	in 1 of 60 cases

The importance of the after-treatment cannot be judged from the present material, in which all were treated alike, *i.e.*, they received practically no after-treatment, but the results attained seemed to be fully on a level with those reported by other authors after a prolonged period of nonweightbearing.

Only 1 case of necrosis of the femoral head occurred in this series. Of 6 hips with traumatic central dislocation, 4 were followed up clinically and roentgenologically after the lapse of from six to twenty-seven years or for an average of seventeen years, and all of the patients had severe symptoms, subjective, objective and roentgenological. The usual treatment with traction is therefore not found to be satisfactory. It is open to question whether better results cannot be obtained by operative reduction.—*R. K. Arbuckle, M.D.*

Stuck, Walter G., and Thompson, Milton S. Complications of intramedullary fixation of fractures of the femur. *Arch. Surg.*, Nov., 1951, *63*, 675–686.

Seventy cases of fracture of the shaft of the femur treated by intramedullary nail fixation are reviewed. By this method patients are restored to normal activity sooner than by any other method of treatment.

The complications are divided into three groups and how to avoid them is discussed. Simple fractures of the middle third offer the fewest complications.

Adequate after care is essential. The nail is withdrawn after one year, but to date no proof that it may be detrimental if left longer is available.—*Joseph Levitin, M.D.*

Scott, J. C. Treatment of trochanteric fractures. *J. Bone & Joint Surg.*, Nov. 1951, *33-B*, 508–512.

In this paper a series of 100 consecutive patients with trochanteric fractures is reviewed. The different types of fracture in the trochanteric region are divided into three main groups: (1) the oblique basal fracture, involving one or both trochanters, with little or no displacement; (2) the same but with varying degrees of comminution and displacement; (3) fracture with reversed obliquity, involving the lesser trochanter and, less frequently, with separation of the greater trochanter. These the author regards as not hard and fast categories. They all merge into each other and it is the complexity of the fracture pattern which makes dogmatism about the suitability of different methods difficult.

The second type provides most of the problems. There are two main reasons for this. Correction of the varus deformity cannot be maintained unless the bar of bone at the medial side of the base of the neck can be restored. The glutei medius and minimus,

pulling through a relatively intact trochanter on to a small fragment, exert a powerful tilting effect. If both deforming factors combine, there is no method that will provide uniformly good results. Such are the cases in which nail-plates break or come apart, and in which the usual methods of conservative treatment do not prevent deformity.

The duration of conservative treatment should vary with the type of fracture. It is safe to discard traction and splintage, the author believes, much earlier in the first type of fracture than in the other two. Some of the failures of conservative treatment arise from the practice of maintaining traction for only eight weeks in all trochanteric fractures.

In the study of the series all deaths within three months after injury were included. There was no great difference in mortality or in functional results between the operative group and the conservatively treated group. One type of fracture gives poor results whatever the method of treatment. The series is regarded as too small for statistical conclusions, but the results suggest that the only advantages of operative treatment are greater economy of hospital beds, and increased comfort and mobility of the patient. The latter factor is important in frail patients, who are believed less prone to develop non-fatal complications if treated by operation than if treated conservatively.—*R. S. Bromer, M.D.*

Apley, A. G. Hyperplastic callus in osteogenesis imperfecta; report of a case. *J. Bone & Joint Surg.*, Nov., 1951, *33-B*, 591–593.

Hyperplastic callus in osteogenesis imperfecta is rare. The author reports his case because it illustrates roentgenologically the development of the condition. An additional point of interest was the occurrence of a fracture of another bone during treatment without the formation of hyperplastic callus. The present case is added to the few previously reported in the literature.

The film exposed five weeks after the onset of symptoms showed a vague shadow in the lower third of the thigh as compared with a roentgenogram of the same femur some years previously. The possible diagnosis of sarcoma or of an acute osteomyelitis was considered. The patient was a girl, seventeen years of age, who had for five weeks previous to admission to the hospital, pain in the thigh which became throbbing in character and worse at night. She had a fever of 102° F. A roentgenogram taken six weeks after the onset of symptoms made the diagnosis clear. This film and the following series of films showed the development of a large mass of calcification of bizarre, almost butterfly shape about the lower end of the femur. This mass gradually became more sharply defined. In no film was there evidence of recent fracture of the lower end of the femur. About three months later the patient sustained a fracture of the lower end of the right tibia and also of the fibula with some displacement and these fractures united without excessive callus.—*R. S. Bromer, M.D.*

Kimmelstiel, Paul, and Rapp, Ira. Cortical defect due to periosteal desmoids. *Bull. Hosp. Joint Dis.*, Oct., 1951, *12*, 286–297.

This is a report of 4 cases presenting a subperiosteal cortical erosion of the condyles of the femur just above the articular surface with vague pain in the knee or a palpable mass. There was a thin zone of hyperostosis demarcating the erosion from the adjacent bone. The eroded area did not have a bony roof.

The diagnosis must be made by the pathologist. The lesion is an unusual one for which the authors suggest the term "periosteal desmoid".—*J. M. Dell, Jr., M.D.*

Hamada, Gawad. Malignant melanoma; report of a case. *J. Bone & Joint Surg.*, Nov., 1951, *33-B*, 600–601.

Few examples are cited in the literature of metastasis to bone of malignant melanoma. The case reported in this paper showed a lesion in the right tibia, the primary focus being a black pigmented, warty lesion on the sole of the right foot. This emitted pus on pressure. The tibial lesion was entirely destructive as shown in the roentgenogram. The author suggests that an injury to the right tibia provoked the development of the tumor by the hematoma arresting a few wandering malignant cells, which proliferated in the tibia.—*R. S. Bromer, M.D.*

Drew, A. J. The late results of arthrodesis of the foot. *J. Bone & Joint Surg.*, Nov., 1951, *33-B*, 496–502.

The late results of arthrodesis of the foot, as a method of treatment for various types of muscular imbalance or paralysis, are discussed in this paper. Of 80 patients who were operated upon, 32 were traced and 27 in whom operation was undertaken for a tarsal arthrodesis were re-examined. The operations were divided into three groups: the triple arthrodesis of the subtalar and midtarsal joints; Dunn's or Hoke's modification; Lambrinudi's modification for drop-foot. The choice of operation seemed to have been determined by the degree of deformity of the foot, the date of operation and the surgeon's individual preference.

In general, the results were most gratifying, particularly from the patient's point of view. Eight patients complained of pain but in 7 it was slight and occurred only occasionally, usually after considerable walking or standing. Half the patients with pain fell in the group submitted to the modified type of arthrodesis. Two factors were apparent. First, the average age of the patient at operation was twenty-six years whereas that of those who had been relieved of pain was seventeen years. Secondly, 2 of the 5 patients with poor roentgenographic evidence of bony union complained of persistent pain. The position of

the foot and the presence of arthritis in the ankle joint did not seem to be important. The author concludes that the threshold for pain has wide individual differences in the foot as elsewhere in the body.

The development of osteoarthritic changes in the ankle joint appeared to have no relationship to the position of the foot, the age at which operation was done, or the soundness of bony union.

The significance of poor roentgen evidence of sound arthrodesis is regarded by the author as difficult to assess. Of the 2 patients with poor subtalar and midtarsal fusion, 1 complained of moderate pain, and of the 3 with indifferent talonavicular or calcaneocuboid fusion, 1 had pain of a mild type. Other disadvantages of unsound fusion, such as risk of further deformity and instability, were not evident in the series.

The importance of a plantigrade foot is apparent, but if there is any residual deformity a valgus is regarded by Drew as preferable to a varus position. The 2 patients who had bony ankylosis of the ankle joint as well as the tarsal fusion were able to manage very well.

The paper is illustrated by roentgenograms of the results of arthrodesis.—*R. S. Bromer, M.D.*

Bastos Ansart, Manuel. Pan-arthrodesis for paralytic flail foot. *J. Bone & Joint Surg.*, Nov., 1951, *33-B*, 503–507.

The author states that paralysis of all foot motors is rare as an isolated phenomenon, but it is common in conjunction with paralysis of other muscle groups in the lower limb. Flail feet undergo plastic changes as a result of mechanical influences to which they are exposed. Treatment depends upon the static and dynamic state of the limb as a whole. If the foot can take weight without varus deformity no operation is needed. Usually, however, operation is required in order to add strength and stability, or to correct deformity. Treatment of the flail foot is recommended when varus deformity and short leg is present and should consist of fusion of the ankle, subtalar and midtarsal joints. The foot should be held in equinus. The author claims as advantages: (1) good stability and prevention of late deformity; (2) compensation for shortening; and (3) ability to wear an ordinary high-heeled shoe which is desirable for cosmetic and psychological reasons. Complete fusion of the tarsus can be obtained by alternative methods: (1) implantation of an anterior bridge graft, or (2) peritalar intra-articular arthrodesis.

The technique of the operations is described in detail and illustrative roentgenograms of results are reproduced.—*R. S. Bromer, M.D.*

deLorimier, Alfred A. Reflex hyperemic deossifications. *Bull. Hosp. Joint Dis.*, Oct., 1951, *12*, 22–37.

Reflex hyperemic deossification is characterized by localized areas of bone dissolution, which are rendered conspicuous by the substantial structure of the contiguous bone. This is the condition originally described by Sudeck. It appears to be an active deossification in the sense that osseous constituents are actually washed out at the sites of abundant blood supply. Leriche and Policard stressed the physiology concerned. They remarked: "If by any process whatever, the activity of the circulation is increased in the vicinity of bone, the latter becomes rarefied." As such, it should be distinguished from the passive type of bone deficiency where there is a lack of normal stimuli for deposit of the inorganic constituents.

Because of the serious consequences of errors in diagnosis, more than 350 cases of various types of spotty deossification were reviewed. These cases were selected from the files representing such lesions as osteoporosis, infectious arthritis, fractures, amputations, transverse myelitis, poliomyelitis, peripheral nerve injuries, tabes dorsalis and various neoplasms. In 239 of the total, a spotty hyperemic type of deossification was found. Trauma was the predominant etiologic factor and a fracture was present in 46 per cent of the cases. Infection was concerned in less than 20 per cent. Hyperemic deossification was observed in 14 of 61 neoplasms of bone.

Although deossification was also noted in cases of prolonged disuse and cases of limited activity such as poliomyelitis or hemophilia, the pattern of bone architecture in these was not that of spotty dissolution but rather that of delicate trabeculations with increased spacing between them.

The distribution of the hyperemic deossification showed three different forms: it extended throughout the shaft when the terminal branches of the main nutrient artery were affected; it was limited to the metaphyseal zones when the perforating metaphyseal vessels and their anastamoses were involved; and it was subchondral when the joint was diseased. This latter form was thought to be the result of hyperemia in the terminal arcuate vessels.

Even though, the roentgenological and clinical aspects of reflex hyperemic deossification appear to be sufficiently unique to consider it a distinct entity, it must be admitted that localized active hyperemic deossifications occur, to a less significant degree, in a number of other conditions. These include caisson disease and sickle cell anemia. Even in osteochondritis there may be scattered areas of vacuolization due apparently to attempts at compensatory vascularization. One might also consider the so-called "corner sign" or the "Trümmerfeld zone" of scurvy as exemplifying dissolutions due to hyperemia of the perforating metaphyseal vessels.—*Frank Hendrickson, M.D.*

Costello, Francis V., and Brown, Austin. Myositis ossificans complicating anterior poliomyelitis. *J. Bone & Joint Surg.*, Nov., 1951, *33-B*, 594–597.

Heterotopic calcification and ossification have been discovered and described in practically every tissue of the body except in the sphincters and in other smooth muscle. The occurrence of heterotopic calcification as a complication of traumatic paraplegia has been described. It has also been observed in neurological disorders such as tabes, syringomyelia and spastic paraplegia.

The authors report 3 cases of intramuscular ossification occurring in the convalescent stage of anterior poliomyelitis. Their purpose in presenting this paper, they state, was not to suggest a new theory about the causes of metastiatic ossification, but merely to record its occurrence in anterior poliomyelitis and to suggest that it may be more common than is generally realized.—*R. S. Bromer, M.D.*

Coley, Bradley L. Atypical forms of bone sarcoma. *Bull. Hosp. Joint Dis.*, Oct., 1951, *12*, 148–173.

During the past thirty years the pathologic concept of bone lesions has changed from that based on cell type to one based on tissue of origin, *e.g.*, round cell, spindle cell, etc., to chondrosarcoma, angiosarcoma, osteogenic sarcoma, etc. Despite these advances, there are still a number of "blind spots" and efforts to improve the survival rate of many malignant varieties have been quite unsuccessful.

This report deals with a few atypical forms, the first of which may be termed *low grade fibrosarcoma of periosteal origin.*

These tumors often seem to arise at the site of a fascial attachment or tendon and actually invade bone rather than arise from it. The experienced pathologist often considers them of borderline character approaching a fibroma in histopathology. The patients usually give a long history of duration and extremely slow growth with several attempts at local excision which have been followed by repeated recurrences. At times the histopathologic appearance of the tumor remains unchanged despite repeated operations, but occasionally successive specimens reveal a progressively more active and less benign lesion.

Two cases are described with very slow growth and multi-recurrences following surgery, which were finally controlled by more radical surgery to include the bone of the involved region. The histopathology and operative procedures are described in both cases.

Next are presented 2 cases of recurrent disease which were controlled by conservative surgery. The pathology was felt to be *malignant soft part sarcoma of osteogenic origin.*

Parosteal osteoma is also described and reference is made to the work of Copeland and Geschickter. The tendency of these tumors to become frankly malignant and metastasize is commented upon and 2 cases are presented to illustrate this.

Osteogenic sarcoma arising on the basis of traumatic myositis ossificans is a rarity and a single case probably of this type is included.

Finally, a case of slowly developing neoplasm of the knee is presented, which, early in its course, was diagnosed as benign and which recurred and finally metastisized, causing death in spite of radical surgery. The course of the disease was eight years from onset to death and five years from amputation to death.

In summary, the author reiterates the common features of the cases presented, emphasizing the difficulty of diagnosis in the early stages. Some therapeutic methods for improving the results in these cases are then suggested.—*J. M. Monaghan, III, M.D.*

Goldenberg, Raphael R. The skeleton in Paget's disease. *Bull. Hosp. Joint Dis.*, Oct., 1951, *12*, 229–255.

The name of "Paget's disease" is preferable to "osteitis deformans" because it allows inclusion of all degrees of bone involvement. The condition is one of the middle and advanced years with an occasional case under twenty. Schmorl observed 138 cases in 4,614 consecutive autopsies, an incidence of 3.3 per cent. Fifty per cent of his cases showed involvement of some part of the vertebral column or sacrum.

The etiology is unknown. The disease is often asymptomatic. Enlarged head, waddling gait and bowlegs may be present in advanced cases. Pain may occur, usually in the lower back or extremities.

Osteoporosis circumscripta cranii is asymptomatic. One of the striking roentgenographic features is thickening and bending of the tibia in the advanced case with a normal fibula. The disease in long bones begins at one end and spreads to the other by an advancing wedge-shaped extension of osteoporosis followed by a process of osteosclerosis. The bones of the hands and feet are rarely involved. The author describes the histopathology and presents several photographs of postmortem specimens, both gross and microscopic, as well as reproductions of roentgenograms. Serum calcium and phosphorus are nearly always normal with the former elevated at times by immobilization for fracture or by associated hyperparathyroidism. The serum alkaline phosphatase is invariably high.

Monostotic Paget's disease is discussed and its existence questioned. Fractures are not uncommon. As a rule, they heal completely, but union may be delayed. From a clinical standpoint the complaint of pain in a bone involved by Paget's disease should make one search for a fracture. Failure to force fluids and to keep the diet low in calcium, in patients with Paget's disease subjected to prolonged immobilization, has been known to result in death from hypercalcemia.

The incidence of sarcoma in Paget's disease is difficult to estimate. Sarcoma may arise when the disease is limited to one bone. In case of widespread Paget's disease, other sarcomatous foci are usually

present or soon become apparent in other affected bones. The usual life expectancy after development of sarcoma is about one year.

Differential diagnosis is discussed. Elevated serum acid phosphatase will rule out Paget's disease.

The treatment is symptomatic. Some subjective improvement has followed the use of aluminum acetate therapy or daily injections of parathormone or teropterin. Irradiation with 800 to 900 r in doses of 75 r twice a week may be of value to relieve pain. Laminectomy may be indicated in cases with spinal cord compression.—*J. M. Dell, Jr., M.D.*

Johnson, Lent C., and Meador, George E. The nature of benign "solitary myeloma" of bone. *Bull. Hosp. Joint Dis.*, Oct., 1951, *12*, 298–313.

The benign form of "solitary myeloma" of bone presents a picture which resembles that seen in eosinophilic granuloma of bone and at times that of the bone marrow in Letterer-Siwe disease and Schüller-Christian disease. The lesion may mimic multiple myeloma, reticulum cell sarcoma and even Ewing's tumor.

Evidence is presented which suggests that a number of infectious agents of mild virulence can provoke within the bone marrow either a granulomatous reaction as seen in eosinophilic granuloma, or a hyperplasia of histiocytes as seen in so-called benign solitary myeloma.

The case presented involved both upper tibiae. This case and several others are cited to show that, like eosinophilic granuloma, solitary myeloma in its benign form may involve several bones.—*J. M. Dell, Jr., M.D.*

Rot, Anton. Ein Fall von Perlmutterknochenerkrankung. (A case of mother-of-pearl bone disease.) *Wien. klin. Wchnschr.*, Oct. 12, 1951, *63*, 782–784.

This is a case report of a rare occupational disease in a mother-of-pearl worker. A twenty-two year old woman was admitted to the hospital because of sudden intensive pain in the right shoulder. Clinically, a smooth swelling of the medial end of the right clavicle was noted with moderate soft tissue swelling and extreme tenderness. Roentgenographic examination showed periosteal thickening at the sternal end of the clavicle. The cortex and medulla were of normal appearance.

The patient was treated with iodine internally and with intensive roentgen therapy with no improvement. An operation was performed removing the excessive periosteal deposition which showed a nonspecific periostosis, probably on a hematological toxic basis. Two weeks after the operation the patient was discharged having no complaints.

In reviewing the literature, the author found cases of mother-of-pearl disease reported in 1869 by English. A more comprehensive work was published in 1875 by Gussenbauers. Teleky collected from the world literature 31 cases in 1908 and Koelsh 50 cases in 1947. Most of the cases were from Vienna, the center of the mother-of-pearl industry.

All authors describe a similar course of the disease. It occurs in young individuals between twelve and twenty years of age. The onset is usually in the early months or at the latest in the first one to two years of employment. Temperature elevation, sudden intensive pain and swelling at localized regions, mostly at the end of bones, are the usual findings. The following bones are commonly affected: ascending ramus of the mandible, lower angle of scapula, clavicle, ulna, radius, metatarsal and metacarpal bones.

Histopathologically, the condition is that of rarefying osteitis.—*Solomon Silvera, M.D.*

Bezold, K. Ein Fall von ausgedehnter Knochenhämangiomatose. (A case of widespread hemangiomatosis of bone.) *Fortschr. a. d. Geb. d. Röntgenstrahlen ver. m. Röntgenpraxis*, Nov., 1951, *75*, 636–641.

A patient, a female aged forty, with hemangiomas involving both iliac bones, the right acetabulum and ischium, right clavicle and the third lumbar vertebra, is described. The patient had vague pains in the low back for three years prior to admission. A biopsy from the right ilium confirmed the diagnosis.

Roentgen therapy (1,200 r focal dose) was given to the region of the right acetabulum to prevent central dislocation of the right hip. The result is not stated.—*K. E. Matzinger, M.D.*

Lawson, T. L. Chronic bone infections in Africans; ten cases from Nigeria. *J. Bone & Joint Surg.*, Nov., 1951, *33-B*, 584–590.

The cases presented in this paper exemplify the diagnostic problems which were met in orthopedic practice among the African population of Nigeria. Lawson regards the positive Wassermann or equivalent test as, by itself, of little significance, for the test is positive in a large proportion of African patients. A diagnosis of syphilis must be based on a combination of all available evidence, clinical, roentgenological and serological. Moreover, he states, a diagnosis of syphilis must be taken to imply syphilis or yaws, for no convincing evidence has been brought forward to allow differentiation between the two diseases.

The following cases are reported with illustrative roentgenograms: generalized syphilitic osteitis, syphilitic epiphysitis, syphilitic osteitis of the left carpus, syphilitic osteitis of the right clavicle, osteitis of the skull probably syphilitic, syphilitic osteitis of the right femur, pyogenic infection of the foot, Madura hand, destructive lesion of the humerus, probably tuberculous, and osteitis secondary to infestation with guinea-worm.—*R. S. Bromer, M.D.*

Shapinker, Samuel, and Minnaar, de Villiers. Syphilitic disease of the long bones in the Bantu. *J. Bone & Joint Surg.*, Nov., 1951, *33-B*, 578–583.

Although syphilitic lesions of bone have become increasingly rare in European communities, syphilis is still a common cause of bone pathology in the South African Bantu. Syphilis accounts for, or complicates, 90 per cent of all bone lesions—apart from fractures—seen in the authors' hospital.

Roentgenograms of 11 cases of syphilitic disease of bone in adults and children are reproduced. In establishing a diagnosis of syphilis, the authors relied upon the following criteria in addition to a positive Wassermann or Eagle reaction: (1) multiplicity of bone lesions; (2) typical roentgenological appearances of other parts—for example, an associated gumma of the clavicle, or a "moth-eaten" appearance of the skull—besides the lesion in the long bones; (3) rapid resolution of the lesion, or of the symptoms, in response to antisyphilitic treatment, which consisted of penicillin, 600,000 units daily; (4) when necessary, biopsy of the bone to exclude any other pathology of bone.

Syphilis was distinguished from yaws by the fact that yaws does not occur in the South African Bantu. It does not extend southwards beyond Northern Rhodesia and it is unknown in the Union of South Africa whence all the authors' cases were drawn.

The "lace appearance" of the periosteum which is seen beneath a syphilitic ulcer is not illustrated by the authors as they state it is common to any chronic ulcer of the leg. Syphilitic periostitis in the adult may be of three types: (1) simple periosteal thickening; (2) irregular "lace-work" type; (3) radiating spicules usually associated with underlying gummata. This last type may be easily mistaken for an osteogenic sarcoma and biopsy may have to be undertaken to prove the diagnosis.

It has been stated that bones affected by syphilis, especially by gummatous osteitis, are more brittle than normal bones and that healing is delayed after fracture. Illustrations are shown of two fractures occurring through bones affected by syphilis. In 1 patient fracture through the shaft of the humerus led to pseudarthrosis. In the second patient, a fracture through the olecranon of the ulna sustained in a motor accident, united without delay and despite the fact that the bone was extensively affected by syphilis and that the olecranon was not sutured.—*R. S. Bromer, M.D.*

Blood and Lymph System

Abeatici, S., and Campi, L. Sur les possibilités de l'angiographie hépatique; la visualisation du système portal; recherches expérimentales. (On the possibilities of hepatic angiography; visualization of the portal system; experimental investigations.) *Acta radiol.*, Nov., 1951, *36*, 383–392.

The authors undertook a series of experimental investigations for the study of the vascular alterations in various diseases of the liver. The system of the hepatic artery can be studied via the retrograde route by means of aortography which has proved so useful for other vascular regions.

As is known, the portal vein has two main tributaries: (a) the superior mesenteric vein which collects the blood from the intestinal veins, the ileocolic vein, the right colic vein, the middle colic vein, the duodenopancreatic vein and the duodenal veins, and (b) the splenic vein which receives the blood from the spleen, the short gastric veins, the left gastro-epiploic vein and especially the inferior mesenteric vein, which is a prolongation of the superior hemorrhoidal vein uniting during its course with the sigmoid vein and the left colic vein. Recently, several attempts have been made to visualize the portal venous system by injecting the opaque substance into the various branches of the two main tributaries during laparotomy. The authors tried to find a method which would accomplish the same purpose without an open operation. Two procedures suggested themselves: the injection of the superior hemorrhoidal vein which is easily accessible and the transabdominal injection of the spleen. The first procedure was found to have many inconveniences and therefore had to be rejected. The second procedure gave more promising results.

In the present article, the authors give an account of the experimental investigations which were carried out on dogs in connection with this second procedure. They have injected the spleen by varying the quantity of the opaque medium, the time of injection and the time of exposure to obtain the best visualization; then at various intervals thereafter they have performed histologic examinations of the spleen to see if any tissue alterations have been produced by the iodized organic compounds.

The technique is described in detail. Briefly, 6–9 cc. of 70 per cent ioduron was injected under intraperitoneal narconumal anesthesia by puncturing the spleen either directly through the skin or through a 2 cm. long incision. In 1 case the superior mesenteric vein was injected following laparotomy for comparison. It was found that the opaque medium diffused so readily through the spleen that the injection had to be made rapidly, usually within four to five seconds. The best roentgenograms were obtained two to four seconds after the completion of the injection, exhibiting as good a visualization of the entire portal venous system as that observed following the operative injection via the superior mesenteric vein. After fifteen seconds the opaque substance had been emptied except for a small retention in the spleen which was only faintly visible on a roentgenogram made one minute after the injection. This prompt elimination of the opaque medium from the

spleen is attributed to the presence in that organ of numerous smooth muscle fibers which undergo vigorous contraction as soon as the injection is made, producing a discharge into the circulation of the dye-containing blood in the form of a veritable "radiopaque embolus."

The histologic examinations showed no major damage to the spleen. There were some lacerations due to the introduction of the needle and the release of the opaque medium but these healed with minor scars. There were also some vascular ectasias and small subcapsular hemorrhages which usually absorbed within fifteen to twenty days. All animals survived and none showed any untoward effects except those due to the anesthesia. It is emphasized, however, that the injection should not be repeated at too short intervals, since degenerative phenomena (fatty degeneration) may occur in the liver cells which are sensitive to iodized organic products.

The authors, in concluding, express the opinion that the method is not dangerous and that it produces no more discomfort to the patient than any of the other numerous methods used at present for angiography in various vascular regions of the body. If executed carefully and employed only in selected cases, it may prove useful also for practical clinical application.—*T. Leucutia, M.D.*

Moore, George E., and Brindenbaugh, Richard B. Roentgen demonstration of the venous circulation in the liver; portal venography. *Radiology*, Nov., 1951, *57*, 685–690.

During surgical interventions in the abdomen, portal venography was carried out as an incidental procedure. A polythene catheter was inserted into one of the tributaries of the portal vein, usually the gastro-epiploic, and 20 cc. of 35 per cent diodrast was injected as rapidly as possible. Upon completion of the injection, a single roentgenogram was made by means of a portable apparatus. Good filling of the portal radicles on the right was usually obtained while good filling on the left was not as constant. Good filling on the left was not obtained without good filling on the right. By increasing the concentration of the diodrast to 70 per cent and delaying the exposure slightly, good hepatograms were obtained. In an unstated number of cases, no serious complications were noted. Extravasated dye is readily absorbed without ill effect.—*M. B. Goodwin, M.D.*

Child, Charles G., III, O'Sullivan, Ward D., Payne, Mary Ann, and McClure, Roy D., Jr. Portal venography; preliminary report. *Radiology*, Nov., 1951, *57*, 691–701.

This is a report on experiences with portal venography and a discussion of its possible usefulness as a diagnostic procedure. Fourteen of the 21 portal venograms done in man are reported in detail. They were done in the course of either an exploratory celiotomy or a definitive surgical procedure. The superior mesenteric vein was isolated at the base of the mesocolon and injection was performed through a No. 15 gauge needle. Forty milliliters of 35 per cent diodrast was employed in almost all instances, injected as rapidly as possible. There were no fatalities and no morbidity which might have been ascribed to the procedure.

It is concluded that portal venography is a simple procedure which does not add significantly to the over-all surgical risk. In several instances, particularly in patients with pancreatic cancer, it has demonstrated its value. Final evaluation of the diagnostic worth of this procedure must await accumulation of additional experience.—*A. W. Sommer, M.D.*

Johnson, Herbert C., and Walker, A. Earl. The angiographic diagnosis of spontaneous thrombosis of the internal and common carotid arteries. *J. Neurosurg.*, Nov., 1951, *8*, 631–659.

Six cases of spontaneous thrombosis of the internal or common carotid artery are presented and 101 previous cases found in the literature are reviewed. In the authors' cases diagnosis was made by angiography or by exposure of the carotid preparatory to angiography.

The most common factors in etiology are arteriosclerosis and thromboangiitis obliterans, with the sites of occlusion of the internal carotid, the carotid bifurcation and the carotid siphon all points of predilection for atheromatous changes.

Most of the cases received no specific treatment, although cervical sympathectomy and arteriectomy were tried without improvement except in one case. Prognosis is poor, with about 25 per cent of the patients showing any improvement with or without treatment.

The visualization of only the external carotid artery in an angiogram is not sufficient evidence for the diagnosis of thrombosis. Films must be taken so that the common carotid and the region of the carotid bifurcation are visualized. Although palpation of the neck may reveal the absence of pulsation of the internal or common carotid artery, and in instances involvement of the ophthalmic artery is suggestive, it is believed that without angiography most of the lesions would not have been diagnosed correctly.—*F. E. O'Neill, M.D.*

Sutton, David, and Hoare, R. D. Percutaneous vertebral arteriography. *Brit. J. Radiol.*, Nov., 1951, *24*, 589–597.

Percutaneous carotid angiography is valuable in investigating pathological changes in about two-thirds of the intracranial contents. Injection of the vertebral artery shows the vessels in the other third. As the carotid and vertebral vessels lie close to each other, the vertebral artery has occasionally been in-

jected during attempted carotid injection, and in a collected series of 1,500 carotid studies, the vertebral was punctured 30 times.

Injection has been made after exposure of the vertebral artery, and also through a catheter introduced into the radial artery, but percutaneous puncture is more suitable in routine investigations. The technique is somewhat more difficult than that of carotid puncture, but it is entirely reliable in experienced hands. The vessel is reached after locating the transverse processes of the second or third cervical vertebra with the needle tip. Films are made in lateral and in Towne's views after injection as in carotid angiography. Submentovertical projections are sometimes useful, although not always necessary. Better studies are obtained if less pressure is used than in carotid angiography. The injection usually shows the basilar artery, the posterior cerebral, superior cerebellar, and posterior inferior cerebellar arteries, and occasionally the posterior communicating and posterior choroidal arteries.

The complications of the procedure are comparable to those of carotid angiography. Periarterial injection has occurred. It is possible to enter the subarachnoid space if the needle is too far medial, and pressure in the system may cause regurgitation in the needle and tubing, simulating arterial pressure. For this reason it is important to see arterial blood in the tubing before injecting the contrast medium.

This method of study is probably the only way of demonstrating vascular lesions in the posterior fossa preoperatively. Aneurysm, angioma, thrombosis, and subdural hematoma can all be localized and identified. Some surgeons feel that it is justifiable to perform vertebral arteriography even when one aneurysm has already been shown by carotid injection, as the lesions are frequently multiple. Intracranial angiomata have been diagnosed by this method with increasing frequency. The value of vertebral arteriography in diagnosis of tumors is less than in vascular lesions, since air contrast studies usually provide accurate localization. Once the technique has been mastered, however, arteriography may become more important in cases with posterior fossa tumor because of the fact that it disturbs normal intracranial dynamics less than do air studies.—*E. F. Lang, M.D.*

Ecker, Arthur, and Riemenschneider, Paul A. Arteriographic demonstration of spasm of the intracranial arteries; with special reference to saccular arterial aneurysms. *J. Neurosurg.*, Nov., 1951, *8*, 660–667.

When cerebral angiograms were repeated on the same patient on different occasions using similar technique and under similar conditions, the cerebral arteries were noted to vary strikingly in size, the narrowing in caliber of vessels obviously due to arterial spasm.

Arterial spasm can be definitely recognized arteriographically when a vessel is of larger caliber in a subsequent angiogram than was demonstrated at a previous examination made under identical conditions. Marked spasm slows the blood stream and in such cases arteriograms must be made with delayed timing. Causes other than spasm may produce localized narrowing, particularly arteriosclerosis, and congenital abnormality.

The authors demonstrated spasm of the larger intracranial arteries (internal diameter at least 1.5 mm.) in 10 patients, the involved vessels being the internal carotid, anterior cerebral, middle cerebral arteries and their major branches. Aneurysms near the circle of Willis, intrinsic lesions of the arteries, localized intracerebral hemorrhage and edema were found to be associated with spasm of larger intracranial arteries. The common element in the production of spasm appears to be abrupt traction on the arterial wall.—*F. E. O'Neill, M.D.*

Wentzlik, Günter. Beitrag zur Technik der Extremitätenarteriographie mit Serienangiogrammen. (Technique of arteriography of the extremities with serial angiograms.) *Röntgen-Blätter*, Nov., 1951, *4*, 298–303.

A simple apparatus for the taking of serial arteriograms is described and illustrated. It consists of a quadrangular drum of light metal upon which four pairs of 15 by 40 cm. cassettes are mounted with the narrow sides of the paired cassettes in apposition. A hand crank through the long axis is used for turning the drum. The apparatus is placed under the roentgen table and thus four films of 15 by 80 cm. total size, covering the area of the entire lower extremity, can be exposed at desired intervals.

The author uses water soluble contrast media (uroselectan or per-abrodil) for the arteriography and obtains satisfactory arteriograms which demonstrate the vessels at different phases of filling.—*Harold Fulton, M.D.*

Chambraud, M. R. La phlébographie pelvienne par voie trans-osseuse. (Pelvic phlebography by trans-osseous route.) *Gynéc. et obst.*, 1951, *50*, 477–491.

For pelvic phlebography, by the transosseous route, the author uses a trocar of about 2 mm. in diameter adapted with a stout stilette having a screw-like point. Under local anesthesia, after easily piercing the cortex, about 20 cc. of 50 per cent diodone (iodide contrast medium) is injected into the spongy part of a pelvic bone in about five seconds. Roentgenograms are made after three seconds and on. Before withdrawal of the trocar a few cubic centimeters of novocain are injected to "wash" the point of bony puncture. The author finds that the best way of visualizing the pelvic plexuses and major veins is by injecting through ischial tuberosities (patient being in the gynecological position). Other

routes of injection for the visualization of the pelvic veins are the pubic bones and the crests of the iliacs.

The advantages of transosseous phlebography are earlier and surer diagnosis of pelvic phlebitis, permitting an early treatment to check its extension into the veins of the lower extremities. It also helps to differentiate puerperal phlebitis from phlebothrombosis, the former starting in the pelvis while the latter originates in the veins of the lower extremities. Several fine pelvic phlebograms illustrate the usefulness of this rather recent roentgen diagnostic technique with apparently insignificant or no hazards.—*J. N. Sarian, M.D.*

General

Cardoen, G. Le syndrome ≪calcinose≫. (On the calcinosis syndrome.) *Acta chir. belg.*, Nov., 1951, *50*, 545–562.

Two clinical forms are described: the localized and the generalized. Both are accompanied by scleroderma. Masses of calcium salts are deposited in the connective tissues and are discharged through fistulous tracts. A third form, tumorous calcinosis, is characterized by localized tumorous accumulations of calcified masses in the neighborhood of joint bursae or tendons. Scleroderma is absent in the latter. The roentgenographic appearances of the first two forms are pathognomonic. Extensive granular or plaque-like calcifications are seen in the subcutaneous and periarticular tissues. An osteoporosis of the skeleton is also noted. Atrophy of the terminal phalanges and hypertrophic arthritic changes of the interphalangeal joints are often present. The third form shows large localized calcified masses, without the extensive involvement of the connective tissues characterizing the two former forms. The skeleton is normal.

Three cases are presented, 2 belonging to the generalized calcinosis group with scleroderma, 1 to the localized tumorous group. Calcinosis accompanying scleroderma belongs in the group of "collagen diseases" and is temporarily improved by cortisone and ACTH.—*Karol E. Matzinger, M.D.*

Freund, Hugo A. Calcinosis; report of case with treatment. *J. Mich. M. Soc.*, Nov., 1951, *50*, 1233–1235.

Calcinosis may be divided into two types: (1) calcinosis universalis, and (2) calcinosis circumscripta. In calcinosis universalis, calcium is deposited chiefly in the cutaneous and subcutaneous tissues, whereas in calcinosis circumscripta it is deposited chiefly in the muscles and tendons. Approximately 106 cases of calcinosis have been reported in the literature. The calcium foci appear symmetrically in the body and the patients notice hard lumps in the soft tissues of the fingers, hands, feet, elbows and in the buttocks.

The general problem of deposition of calcium salts in soft tissues is discussed and a number of conditions, such as calcium deposition in infarcts, in traumatic lesions and inflamed tissues are grouped under the term of dystrophic calcification. It has been suggested that hormones, enzymes and vitamins may play a part in the production of abnormal calcium distribution as in hyperparathyroidism, excessive use of irradiated ergosterol and prolonged administration of vitamin D.

The author's case was that of a fifty-three year old white man, who, in 1946, noticed lumps on the palms of his hands, soles of his feet, inner aspect of each buttock and at the elbows. The skin of the hands and feet became quite taut and on the right hand it eventually broke down and a gritty material was discharged from the area. The patient became progressively weaker and lost considerable weight.

The patient was examined by the author in January, 1948, at which time hard masses and tightness of the skin over both hands and feet were found. Non-tender nodules varying from 3 mm. to 1 cm. in size were felt in the palms of both hands and over the heads of the metacarpals at the junction of the second and third digits. Similar hard masses were noted in the soft tissues of each buttock. The skin of the hands, and to a lesser extent of the feet and face, was tense and had lost much of its elasticity.

Roentgen studies of the skeleton made at Harper Hospital showed extensive calcium deposits in the subcutaneous tissues of the digits of both hands, of the posterior aspects of both elbows, of the plantar aspect of the right foot at the site of the attachment of the plantar structures to the os calcis, in the region of the buttocks and about both pubic bones and ischial tuberosities. Roentgenograms of the chest, skull and gastrointestinal tract remained negative. The laboratory reports of the blood, urine, basal metabolism, Kahn test, electrocardiogram, hippuric acid liver function test, glucose tolerance and urea clearance tests were normal. The sedimentation rate was 69 mm. (Westergren). The blood calcium was 10.3 mg. per cent and the phosphorus 4.1 mg. per cent. The acid and alkaline phosphatase studies showed normal values.

Biopsy of a nodular mass of the right buttock revealed collagenous connective tissue with extensive deposition of calcium. Subepidermal fibrosis was also found (scleroderma).

No consistent therapeutic results have been reported with any form of treatment. Parathyroidectomy, production of acidosis with ketogenic diet and vitamins in massive doses have been tried.

The author used vitamin E in the form of alpha-tocopherol phosphate on the supposition that it may have an inhibitory effect on the enzyme controlling calcium and phosphorus metabolism or that it may act as a water soluble phosphate ester. One hundred milligrams were given three times daily.

In four weeks the patient stated that he felt generally better and had gained some weight; he could open and close his hands more freely. After three months the hard lumps became softer and he felt considerably improved. Roentgenograms were made of the hands in February, 1948, and again in July, 1950, showing the soft tissues.

The conclusion is reached that calcinosis circumscripta associated with scleroderma responds favorably to the use of alpha-tocopherol phosphate.—*C. W. Cooley, M.D.*

Hess, W. E. Myositis ossificans occurring in poliomyelitis; report of a case. *Arch. Neurol. & Psychiat.*, Nov., 1951, *66*, 606–609.

The author reports a case of myositis ossificans in a seven year old female, a poliomyelitic paraplegic patient. This is believed to be the first case so reported (myositis ossificans occurs in 4 per cent of the paraplegic patients due to other causes).

The patient was hospitalized twenty-four days after onset of acute illness. On admission, strength of the muscles of the upper extremity was normal; of the abdomen and back muscles, fair; of the lower extremities, practically zero.

Routine physical therapy was instituted, including hot packs, muscle re-education, passive stretching of taut muscles, and bed rest, using a firm mattress. Active and passive physical therapy continued, while hot packs were stopped after six weeks. Three months after admission, an oblique right mid-femoral fracture occurred during muscle stretching. In addition to the fracture, immediate roentgenography showed amorphous calcium deposits in the soft tissues of the thigh.

The fracture was reduced and immobilized in a plaster cast for three months, at which time roentgenograms made after removal of the cast showed increase in calcium deposits in the soft tissues and extensive callus formation with good healing of the fracture.

All laboratory data, including serum calcium, phosphorus, and alkaline phosphatase, were normal.

A note of caution is sounded by the author against overstretching and the dangers that may arise; namely, myositis ossificans and fracture of bones.—*W. H. Shehadi, M.D.*

RADIATION THERAPY

Watson, T. A., and Burkell, C. C. The betatron in cancer therapy. Part I. *J. Canad. A. Radiologists*, Dec., 1951, *2*, 60–64.

In the summer of 1948, a 25 mev. betatron was installed at the Physics Department of the University of Saskatchewan. Treatment of selected advanced cases of malignant disease was started in March, 1949. Up to the writing of this paper, 75 patients have been treated. After omitting those patients whose treatment has been too recent plus those in which treatment was not completed, a total of 58 patients remain for consideration, of whom 26 are alive and 32 are dead. The authors ask that this record not be hastily judged as poor since all had advanced disease, many of them recurrent following surgery or radiation therapy. They state, "if one of these patients survives five years, we will be well satisfied."

Biological effects, dosage distribution, as well as constitutional, local tissue, and skin reactions of the 25 mev. betatron therapy are discussed.

The biological effects of radiations are undoubtedly caused by ionization in the tissues. The method of production of the ionization varies, although in each case it is finally brought about by the setting in motion of electrons. For this reason, one would expect no biological difference from the effect of 200 kv. and 20 mev. roentgen rays. At 200 kv. most of the ionization is produced by the Compton effect (very little by photoelectric absorption); at 20 mev., however, ionization is produced by the Compton electrons and pair formation about equally.

Regarding dosage distribution, the authors found that with 22 mev. roentgen rays the maximum dose is obtained at a depth between 3 and 5 cm. whereas the surface of the skin receives very little. Therefore, from a physical point of view, the betatron offers considerable advantages in treatment of deep-seated lesions. The surface dose is small whereas a very high depth dose can be obtained. There is very little scatter outside the beam since almost all the electrons are scattered in a forward direction. The authors express the given dose by stating the maximum dose received at 4 cm. depth—that is, at the 100 per cent level.

The reactions observed in betatron therapy are discussed under the following three headings:

(1) Constitutional reaction. Large volumes in the pelvis and chest were treated in most instances. No patient, however, developed radiation sickness, bearing out the physical calculation of a lower integral dose for a given dose to a volume, compared with conventional roentgen rays. In all cases weekly blood counts, including differential white counts and platelet counts, were made. In no patient did the white count fall below 3,000 cells per cu. mm., and usually it was unaffected. No significant change in the red cell count, hemoglobin level or platelet count was found.

(2) Local tissue reaction. This was found to be the limiting factor in dosage. Towards the end of treatment to the pelvis (virtually the whole pelvis was irradiated in each case), diarrhea and/or urinary frequency usually developed and in some patients was sufficiently severe to force termination of the treatment. When large volumes of the chest were irradiated, the limiting factor was often the reaction inside the esophagus, characterized by dysphagia or increasing pain on swallowing.

(3) Skin reaction. Most patients showed no erythema. A few patients developed a mild erythema with a skin dose as low as 2,000 r in three weeks, but usually erythema did not appear in patients receiving less than 3,000 r in three weeks. All these figures refer to large fields.

In spite of the large fields used, the tolerance levels were not limited by either the constitutional effect of the radiation or the skin reaction but by the local reaction of the tissues within the irradiated volume. Thus, when the pelvis was being treated, it was the diarrhea and tenesmus secondary to the effect on the bowel which limited the dose which the tumor could be given. In patients with carcinoma of the lung, mediastinum or esophagus, it was the dysphagia caused by the inclusion of the esophagus in the irradiated zone which limited the dose. In patients with pelvic carcinoma a dose of 6,000 roentgens, and in patients with thoracic carcinoma a dose of 6,500 roentgens (as determined by the Victoreen r meter), given in an over-all time of three weeks, was found to be the maximum which the tissues could tolerate. Even with this dose, the reactions occasionally were so severe that hospital care with intravenous feedings were necessary to tide the patient over the reaction phase.

The dosage level was found, in a majority of patients, to cause disappearance of the tumor. Unfortunately, however, there was often a local recurrence indicating a failure of treatment from inadequate dosage. With this in mind, the over-all time was increased to five weeks and the tumor dose raised to 7,500 roentgens. Again the limiting factor has been the local tissue reaction. Too little time has yet elapsed to say whether the tumor lethal effect has been enhanced by this change.—*Ralph F. Niehaus, M.D.*

Hornberger, Wilhelm. Jackson-Epilepsie nach hochdosierter Chaoul-Nahbestrahlung eines Schläfenmelanoms. (Jacksonian epilepsy after high dosage Chaoul contact irradiation of a melanoma of the temple.) *Strahlentherapie*, 1951, *85*, 459–477.

In addition to reviewing some of the literature pertaining to cerebral damage during radiation therapy and several cases of "apoplectic" deaths after radiation therapy about the head, the author reports a case of jacksonian epilepsy developing in a patient subjected to high dosage contact therapy.

A thirty-six year old woman who had developed a tendency to have headaches sought treatment for several pigmented nevi in the left temporal and frontal regions. Biopsy revealed "pigmented nevus of the large-cell type; suggestion of beginning malignancy." With a Chaoul tube at a focal-skin distance of 5 cm. and a kilovoltage of 60, 18,000 r was administered from Aug. 5 to Sept. 15, 1948, in single doses of 300–600 r. Also, with 185 kv., 0.5 mm. Cu, and a f.s.d. of 40 cm., 7 fractions of 300 r were administered to the lymph nodes at the angle of the left mandible.

On Jan. 25, 1949, the patient was re-examined and showed an atrophic radiation scar on the left temple. She complained of frequent headaches. On May 19, 1949, the scar on the left temple was not extraordinary, but she complained of continued headaches and a seizure in which the head was turned to the right. Subsequently seizures became more frequent and generalized. They were preceded by a scream and followed by a feeling of lethargy. An encephalogram on Jan. 19, 1950, showed slight dilatation of the left lateral ventricle. The cerebral sulci were coarse on the right and were not outlined by air on the left side.

The last follow-up in Oct., 1950, was only indirect and revealed that the patient could no longer do her housework.—*H. G. Moehring, M.D.*

White, George, and Christensen, William R. Control of inoperable oral cancer with massive roentgen therapy. *New England J. Med.*, Nov. 8, 1951, *245*, 719–723.

The authors present a comparative analysis of 118 patients with inoperable oral cancer treated with roentgen therapy. This group was divided into 55 patients who previously received under 7,000 r and 63 patients who received over 7,000 r by massive roentgen technique. All patients were accepted for treatment regardless of the extent of the primary lesion or of the metastases, as the purpose of the study was to determine the response of the primary disease to the two methods of therapy. All the lesions in this group were epidermoid carcinomas although from various sites. There was no modification of the technique of irradiation dependent on histopathological grading. None of the patients were lost to follow-up.

In administering treatment the preliminary step was improvement of the status of the oral hygiene and removal of all teeth, if possible, or as a basic minimum, removal of at least those teeth which were in the path of the roentgen-ray beam. Treatment was carried out through one intraoral and three external portals. The average diameter of the intraoral portal was 4 cm., although some cases accommodated 4.5 to 5.0 cm. cones. The intraoral treatment was given at the rate of 400 r daily for an average total of 6,000 r in air delivered within fifteen days. The external portals included two lateral and one submental area. These portals were treated simultaneously with the intraoral cone alternating each external portal on successive days. It is emphasized that this type of roentgen therapy must be administered rapidly as the radiation reaction makes it difficult and painful to employ an intraoral cone later. No attempt was made by this technique to include the metastatic lymph nodes of the neck. These were considered a separate problem.

The radiation reaction was marked with the mucositis being well established at the end of two weeks; at the end of the treatment time, usually lasting about thirty days, the patients were markedly uncomfortable and special attention was paid to the oral hygiene with chemotherapy being employed as a prophylactic measure. This second group of patients received a tumor dose of between 9,000 to 12,000 r. The radiation reaction required three months to regress. As might be expected with such massive dosage, a high instance of radiation sequelae developed. In the group below 7,000 r there were essentially no sequelae, but in the group above 7,000 r approximately 25 per cent of complications occurred, divided between ulceration and necrosis. The results obtained are shown in Table 1.

Table I

	Under 7,000 r	Over 7,000 r
No. of patients treated	55	63
Average tumor dose	4,100 r	9,500 r
Persistent or recurrent disease 1 year	36	16
Persistent or recurrent disease 1 to 3 years	2	0
Dead 1 year, no local recurrence	11	12
Dead 1 to 3 years, no local recurrence	5	10
Living over 3 years, no local recurrence	1	13
Sequelae: radiation ulcer or osteitis or both	1	14

The authors emphasize the strong presumptive evidence that if there was absence of any local lesion at the end of one year, the local carcinoma had been controlled. With the massive tumor doses effective for local control the high incidence of radiation complications was considered as a part of the inherent risk necessary to administer a curative dose.—*T. D. Allison, M.D.*

Goolden, A. W. G. Radiation cancer of the pharynx. *Brit. M. J.*, Nov. 10, 1951, *2*, 1110–1112.

The author gives 4 case histories of patients who developed tumors of the laryngopharynx twenty-six to thirty years following radiation therapy of the neck. Three of the patients had been irradiated for thyrotoxicosis. The fourth patient had been treated for tuberculosis of the lymph nodes.

The 3 patients treated for thyrotoxicosis fulfill the criteria considered to be important in the diagnosis of radiation cancer: (a) radiation was used primarily in the treatment; (b) there was an adequate latent period between irradiation and development of the tumor; (c) neoplastic change occurred only in tissue which had suffered appreciable radiation change; (d) radiation tumors often display some abnormality in respect to sex and age incidence, anatomic site, or microscopic appearance.—*K. R. Kaess, M.D.*

Cade, Stanford. The influence of radiology in the diagnosis and treatment of intrinsic carcinoma of the larynx. *Brit. J. Radiol.*, Nov., 1951, *24*, 582–588.

Intrinsic carcinoma is limited to either the true vocal cord or to the ventricle of Morgagni. The usual spread of the former is anteriorly to the commissure and from there to the opposite cord. Less frequently it spreads to the arytenoids. When it spreads downward, the prognosis is particularly poor. Lesions originating in the ventricle may involve only the ventricle, the ventricular band, or the false cord, and these usually spread forward to the base of the epiglottis.

Benign papilloma and keratosis are conditions generally recognized as precancerous, and may remain benign for five to twenty years before becoming malignant. Radiation therapy of these conditions is not satisfactory, and when cancer is associated with keratosis the cancer may be eradicated only to have a new malignancy develop in another portion of the keratosis.

Roentgenologic methods of examination aid in determining the site and extent of the lesion, particularly its downward extension; repeated examinations during treatment show its rate of response and thus its radiosensitivity; the development of edema during treatment and recurrence after treatment are also shown. The routine examination is soft tissue roentgenography in anteroposterior and particularly lateral projections. Frequently of greater value is body section roentgenography which is more satisfactory than even direct laryngoscopy for displaying subglottic extension.

Early intrinsic carcinoma of the larynx without cord fixation can be treated successfully in a large proportion of cases by radiation therapy or by surgery. The usual operation is laryngofissure, and if the lesion is too advanced for this, the practical operation is laryngectomy. There are several methods of irradiation available: radium needling after preliminary fenestration; teleradium application; conventional roentgen therapy; and supervoltage roentgen therapy. The author has used surgery and radium, both as needles and in a teleradium unit, in the treatment of 153 patients.

In an analysis of the failures among the cases treated by irradiation, the author has come to several conclusions. In general, the earlier the lesion, the more likely it is to regress with radiation therapy. In advanced cases still operable, laryngectomy should be considered the main therapeutic measure, instead of considering radiation therapy. Also, when there is subglottic extension the lesion is very difficult to control by irradiation. Likewise the combination of keratosis and cancer is difficult to cure by irradiation,

and large doses must be used. Laryngofissure is the treatment of choice if the lesions coexist, but if irradiation is to be used, radium needles after fenestration provide the most suitable means for administering the necessarily large dose. Another failure of radiation treatment is the management of postirradiation local recurrences.

The author states that early intrinsic carcinoma of the larynx can be treated with radiation therapy and laryngofissure with an equal chance of success. The two exceptions to this are cases with subglottic extension and cases with keratosis of the larynx.—*E. F. Lang, M.D.*

Paterson, Ralston. Breast cancer. *Fortschr. a. d. Geb. d. Röntgenstrahlen ver. m. Röntgenpraxis*, Dec., 1951, *75*, 132–137.

The author considers the present opinion in Great Britain regarding the treatment of cancer of the breast. Irradiation may be employed in the treatment of this condition in the form of roentgen therapy, radium implant and radium mould.

It is generally agreed that when radiation therapy is used in association with surgery it may be as pre- or postoperative irradiation or as both. It may be applied alone in inoperable cases as a palliative agent with possibility of a cure.

Radical surgery is the treatment of choice in the early cases. While irradiation may be employed either before or after surgery, it is the author's opinion that if it is shown by microscopic examination postoperatively that the axillary lymph nodes were not involved irradiation can be withheld, provided the patient is observed at frequent intervals. At the first sign of recurrence full treatment can be given.

In the locally advanced cases with axillary involvement but without distant metastasis, irradiation alone offers not only occasional cures but almost consistent partial resolution. Baclesse of the Fondation Curie employs protracted treatment courses of from twelve to fifteen weeks while in Manchester a five week roentgen course or radium implant is used.

In the middle group between the above two classes are cases which are technically operable but in which decisions regarding surgery and irradiation offer real problems. Radiation therapy will consistently produce resolution of both primary tumor and metastatic lymph nodes and permit longer survival. The author feels there is sufficient evidence to believe the best results should be obtained by preoperative irradiation followed by surgery after resolution with fibrosis has occurred.

The last group includes the late cases which have metastasized and are incurable. The palliation offered in this group by irradiation is spectacular.—*Joseph N. Ané, M.D.*

Bell, John W., Meigs, Joe V., and Swan, Charles H. Carcinoma of the cervix; survival in 98 cases treated with five-day radium only. *New England J. Med.*, Nov. 1, 1951, *245*, 684–688.

The authors deal with a selected group of patients studied over a twelve year period in whom radium alone was used. Most of these cases were treated with the five-day method of interstitial radium application. A total of 262 cases were treated with a variety of radium dosages, ranging from 3,000 to 9,000 milligram hours over the five-day period. The last case treated was followed five years.

The plan of radium treatment in this group consisted of the insertion of platinum needles into the cervical growth. The needles containing 1, 2 and 3 mg. of radium had a wall thickness of 0.5 mm. of platinum and were 60, 44 or 27.7 mm. in length. No central applicator was used.

Of the 98 patients, 24 advanced cases also received palliative roentgen therapy.

The carcinoma was classified according to the classification of the American College of Surgeons which later was converted into the International classification. The following was the distribution: Stage I, 19 cases; Stage II, 36 cases; Stage III, 38 cases; and Stage IV, 5 cases.

Numerous complications are given with postirradiation fibrosis as the most prevalent.

A total of 47 cases survived the five year period; only 15 of the number well at the five year period were alive after a ten year period. Meigs is quoted as having reported 1,764 cases of all stages who had a combination of radium and roentgen therapy and of which only 20.3 per cent were five year cures.—*R. J. Reeves, M.D.*

Stuart, M. Étude de la survie des malades atteintes du cancer du col utérin traitées uniquement par radiothérapie (Ra et Rx). (Study of the survival of patients with cancer of the cervix uteri treated only by radiotherapy [radium and roentgen rays].) *Bull. Assoc. franç. l'étude cancer*, 1951, *38*, 431–440.

The author studied the fate of patients with radiologically treated cancer of the cervix after the fifth and up to the twentieth year. From 1921 to 1944, 1,444 cases of cancer of the cervix in Stages I, II, and III were treated at the Institut G.-Roussy by roentgen and radium therapy. Cases in Stage IV were not included in this survey. The five year survivals numbered 642, a rate of 43 per cent for all three stages together. However, if the starting point be taken at the beginning of the sixth year and the number of survivals at that time considered 100 per cent, there were 81 per cent alive at the twelfth year, 76 per cent at the fourteenth year, 67 per cent at the sixteenth year, and 45 per cent at the twentieth year. The mean age of the patients at the time of treatment was fifty-five years. If these survival rates are plotted on

a graph, the curve thus described is practically equivalent to the survival curve for all women in the general population between the ages of fifty-five and sixty on the basis of normal life expectancy for those age groups. From this study, one may affirm, in general, that a woman with cancer of the cervix in Stage I, II, or III, who was treated by radiation therapy and who survived five years has the same life expectancy as a woman of the same age who did not have cancer of the cervix.—*S. M. Silverstone, M.D.*

Renner, W. Untersuchungen an 68 nach Semikastration bestrahlten Seminompatienten mit und ohne Metastasen. (Observations on 68 patients with seminoma of the testicle with and without metastases irradiated following semicastration.) *Fortschr. a. d. Geb. d. Röntgenstrahlen ver. m. Röntgenpraxis*, Nov., 1951, *75*, 577–583.

The author analyzed a series of 68 patients with seminoma of the testicle who were irradiated following operation and kept under observation during 1932–1950 in the Radiation Institute of the University of Hamburg. All those receiving prophylactic roentgen therapy had the involved testicle removed previously. It is important to start treatment as soon as feasible after the operation. In cases with metastases at the time of the first examination, preoperative irradiation should be considered since evidence has been presented indicating that the operation induces a more rapid growth in the secondary lesions. In that case the involved testicle should also be irradiated.

The following technique was used by the author: 180–190 kv., 4 ma., 40 cm. focus-skin distance, half-value layer 0.9 mm. cu. Two lower and two upper abdominal and posterior fields were exposed through ports of entry of 10 by 15 cm. At one to three day intervals 300–500 r surface dose was applied. Depending on how the treatments were tolerated, one or two fields were exposed in one day. The dose effective in the region of the preaortic lymph nodes amounted to approximately 2,500 r. If there was any suspicion of metastases, the same dose was repeated after three months. In the presence of proved metastases, in addition to the areas used for the prophylactic series the remaining lymphatics were treated with a tumor dose of approximately 5,000 r. Scrotum and inguinal regions were irradiated only in cases where the tumor had invaded the scrotum.

Seventy per cent of the patients were between twenty-five and forty years old; the average age in the entire group was thirty-nine years (with metastases) and thirty-eight years (without metastases). Forty-four patients were followed for five years or more; the five year survivals were 80 per cent (no metastases at operation) and 30 per cent (with metastases at operation). From a review of the literature, it appears that the right testicle is more often involved than the left; the prognosis for seminoma of the left testicle seems to be more favorable than for the right. These observations may be explained by the fact that the right testicle descends later. The author also noticed that the first sign of swelling of the testicle was observed by more than 50 per cent of the patients in the winter months January and February.—*E. A. Phole, M.D.*

Crawford, G. Marshall, Luikart, Ralph H., Jr., and Tilley, Robert F. Roentgen therapy in acne. *New England J. Med.*, Nov. 8, 1951, *245*, 726–728.

The authors present their interesting observations on the skin of the face of 58 patients who had been treated by roentgen means for acne more than five years previously. All patients had received essentially the same therapy. The elapsed time between the treatment and the observation varied between five and twenty-one years. The maximum dose over a single area ranged from 500 r to 1,450 r. This was given with 75–100 kv., unfiltered, in single doses of 60–75 r to each side of the face at weekly intervals. The total dose depended on the degree of involvement and response to treatment. The acne was considered moderate in 30 cases and severe in the remaining 28. The clinical results were excellent in 35 patients, unsatisfactory in 4, and in the remaining 19 cases there were occasional mild recurrences.

The follow-up examinations revealed no atrophy, pigmentation, depigmentation, or keratoses. Nine patients had telangiectasia of a mild degree. This represented 15.5 per cent of the group. Of these 9 cases, 5 had received less than 800 r and 1 had received 1,200 r or more.

The authors conclude that no significant late radiation sequelae should be anticipated with this form of radiation therapy for acne. The best results were in cases receiving 1,000 to 1,200 r in an uninterrupted course.—*T. D. Allison, M.D.*

Ferriera, Octavio Almerindo. A radioterapia no tratamento das bursites. (Radiotherapy in the treatment of bursitis.) *Rev. méd. aeronaut.*, 1951, *3*, 703–706.

The author reports satisfactory therapeutic results in a total of 291 patients suffering from bursitis. In the majority of the cases the diagnosis of the disease was clinical; only 14 cases showed roentgenologic evidence of calcifications. Four of these latter patients exhibited complete disappearance of the calcifications in the course of the treatment; in 5 cases no change whatever in the size or appearance of the calcifications was observed following roentgen therapy.

The favorite treatment factors were: 160 kv., 15 ma., filtration of 0.25 mm. Cu plus 1 mm. Al. A treatment series comprised ten to twelve individual exposures, the first five administered on alternate

days and the remaining at intervals of three days. The first two treatments were given with anti-inflammatory doses of 75 r, the remaining with doses of 125 to 150 r. Due to technical difficulties, the author had to use the lower voltages of 130 kv. produced by superficial roentgen therapy machines in about 80 of the cases. He believes that these lower voltage treatments produce the same satisfactory results as 160 kv. therapy and are superior to the higher voltage treatments with 180 to 200 kv. which he used in the beginning. Frequently the first treatment resulted in an exacerbation of the pain; improvement of the patient's symptoms appeared, as a rule, after the third or fourth treatment. Only 3 cases developed untoward reactions, consisting of headache and nausea.

The author concludes that roentgen therapy is the treatment of choice in bursitis and that the action of the roentgen rays in the disease is based on their analgesic effect. The therapeutic results seem to depend more on the dosage applied than on the kilovoltage used which appears to be of minor importance.—*E. A. Schmidt, M.D.*

Bente, D., and Schneider, W. Die indirekte Bestrahlung der multiplen Sklerose und anderer neurologischer Krankheitsbilder. (Indirect irradiation of multiple sclerosis and other neurologic diseases.) *Strahlentherapie*, 1951, *85*, 445–458.

By indirect irradiation the authors mean irradiation of the paramedian sympathetic nerve trunks. Such irradiation, they assume on the many bases cited, disturbs the irritability or readiness to respond of neural elements by altering the metabolism of paraneural cells in and about the sympathetic trunks and ganglia. For example, in cases of so-called salvarsan-resistant lues, arsenic can be made therapeutically effective by well-timed indirect irradiation.

The evidence that the sclerotic foci in multiple sclerosis depend on vascular changes becomes more convincing. Further, diseases which bespeak disturbed coordination in the vegetative nervous system are more frequently listed in members of families of patients with multiple sclerosis than in others; *e.g.*, asthma, eczema, migraine and spastic constipation.

The therapeutic technique has been: 180 r (h.v.l. of 0.65 mm. Cu; 185 kv., 4 ma., 0.5 mm. Cu at 40 cm. f.s.d.) given to 10 by 15 cm. cervical, thoracic, lumbar, and occasionally sacral fields. Treatment is administered vertically and paramedially so that the vertebral column is avoided. Only one region is treated at a time in order not to conflict with the "cyclic rhythm" of the vegetative nervous system. Treatments are administered at intervals of six to eight days. The field size is decreased to 8 by 10 cm. if radiation sickness appears and the dose is reduced to 150 r or less when lumbar fields are irradiated, especially in young females. After three to four treatments, the series is ended, to be repeated in six to ten weeks.

A series of cases are reported. Best therapeutic results seem to be attained when multiple sclerosis is treated in its early stages. Cases which have been gradually progressive over a period of years are not suited for radiation therapy, but signs and symptoms newly appeared may be benefited.

The authors feel that indirect irradiation is effective in multiple sclerosis and, from scattered but significant observations, in certain cases of syringomyelia and progressive muscular dystrophy.—*H. G. Moehring, M.D.*

RADIOISOTOPES

Copeland, Murray M. Evaluation of radioactive isotopes as an adjunct to surgical diagnosis and therapy. *J. Bone & Joint Surg.*, Oct., 1951, *33-A*, 1021–1030.

The author's purpose in this communication is the presentation of an evaluation of current investigative work with radioactive iodine and radioactive phosphorus as well as with other isotopes of practical interest to the orthopedic surgeon. Tracer and diagnostic problems are possible of solution because appropriate radioactive isotopes, when used in minute quantities, are readily identified by special instruments; yet their radiations are not of sufficient strength to damage tissue or derange function. If a radioactive isotope is used for biological or medical purposes it must meet many exacting requirements. The chemical substance must be nontoxic in the doses required and must be free from impurities or radioionizing daughter substances. The isotope must have a reasonably short radioactive half-life, so that radiation will not persist beyond the desired period, and it must not localize in a damaging concentration at areas other than those to be treated. Its half-life, however, must be of sufficient duration to allow its use in conversion to useful compounds and to permit transportation from the laboratory of its source to the clinic where it is to be administered.

Two general types of investigation with radioactive isotopes in medicine are being carried out: tracer or diagnostic studies, and the use of radioisotopes in therapy.

Of the available isotopes, radioactive iodine (I^{131}) is thought by many to have the greatest diagnostic and therapeutic value. The short half-life of eight days and the problems of accurate assay have for a long time prevented its acceptance in clinical use. It is now being employed extensively, however, in both the diagnosis and therapy of thyroid diseases. Its value has been exemplified as a biological tracer in patients with cancer of the thyroid in whom, through its use, it can be demonstrated that there is a fundamental difference between the normal and cancerous tissue of the thyroid gland. The author summarizes results of experimental work to date on tracer or di-

agnostic use of I^{131} as well as its therapeutic use.

Radioactive phosphorus (P^{32}) is the isotope of second greatest importance and holds considerable interest for orthopedic surgeons, especially those who are concerned with the growth and metabolism of bone as well as with disease processes of the medullary cavity and osseous structure. Present studies indicate that the initial uptake of phosphorus is highest in the liver and that approximately 75 per cent of body phosphate is stored in the bones and teeth. Of the body phosphate, 80 per cent is deposited as a stable portion of the bones and teeth and 20 per cent as a labile portion which is in dynamic equilibrium with the phosphate of the blood plasma. This exchange seems to take place by surface absorption and comes to equilibrium in about two hours after injection, as shown by the use of radioactive phosphorus (P^{32}). In rachitic rats, vitamin D favors the deposition of absorbed phosphate in the bones, as against the soft tissues, and partially inhibits the re-excretion of phosphate in the intestine. A single dose of vitamin D exerts its maximum effect on the uptake of P^{32} in rachitic bone in from fifty-four to seventy-two hours. Experimental work with radioactive phosphorus in animals has shown that the growing epiphyses of bones turn over phosphorus in a ratio of four to one, as compared with the shafts of the bones. In phosphorus deficiency, there is a shift of phosphorus concentration from bone to the soft parts. At the same time, there is a decrease in urinary phosphorus excretion and a corresponding calcuria. Where calcium deficiency obtains, less phosphorus is deposited in the bone and a larger amount is excreted in the urine.

The teeth utilize and exchange, through the pulp and the dentine, a relatively low amount of phosphorus under normal conditions. Very little phosphorus is picked up through the intact enamel unless there are areas of tooth decay. The use of P^{32} is given in detail in disease conditions, together with experimental work.

P^{32} has not proved successful in the treatment of primary bone tumors, although its supplementary use with other forms of irradiation has been suggested. The results in the treatment of multiple myeloma, Hodgkin's disease, lymphosarcoma and metastatic carcinoma of the breast with radioactive phosphorus have been indifferent. An occasional case will show temporary relief from pain and regression of tumor with improvement of general well-being for a brief period of time. Rarely is re-ossification noted.

The author discusses certain other radioisotopes of practical importance to the orthopedic surgeon. Radioactive calcium (Ca^{45}) has peak intensities of beta emissions which make it difficult to use in tracer studies. The low intensity of the radiation, together with its wide concentration in bone, detracts from its usefulness as a therapeutic agent.

Radioactive strontium (Sr^{89}) has been found suitable for biological investigations as it is more easily detected than calcium (Ca^{45}). There is, however, a biochemical difference between the two elements; while strontium is capable of replacing calcium to a considerable extent in the bones, Shipley and his associates have pointed out that it cannot replace calcium in the formation of normal bone. Copeland states that it therefore seems necessary to evaluate both Ca^{45} and Sr^{89} in tracer studies of bone, utilizing the combined results to unravel further the mysteries of bone metabolism. The experimental work and tracer studies in various disease conditions are summarized for both strontium and calcium.

Gallium (Ga^{72}) has been shown by Dudley and his colleagues to be an avid bone-seeker, and considerable interest has been aroused in the possibility of this tool for the study of bone metabolism. More recent studies have indicated that it may be used as a diagnostic means and Copeland states that it deserves investigation as an agent of therapy in bone tumors. It has been demonstrated that radioactive gallium is found in young rabbits principally at the epiphyseal junctions of the long bones in eight hours. Intravenous tracer doses of gallium (Ga^{72}) were selectively concentrated in both osteogenic and osteolytic lesions of bone in 15 of 18 patients with primary and malignant metastatic bone tumors. Early metastases to bone were identified before changes were apparent by roentgen examination.—*R. S. Bromer, M.D.*

Sweeney, Bernard J., Daughaday, William H., Gottlieb, Leo, Scott, Wendell G., and MacBryde, Cyril M. Radioactive iodine therapy of hyperthyroidism; determination of optimum dosage. *South. M. J.*, July, 1951, *44*, 648–654.

The authors have treated 300 patients with hyperthyroidism with radioactive iodine between May, 1947, and December, 1950. One hundred fifty-five of these who have been followed for a period of from six months to three years are discussed.

Patients with hyperthyroidism associated with diffuse goiter, multinodular goiter, postoperative recurrent goiter, and postirradiation recurrent goiter were treated with a satisfactory remission in 117 instances (76 per cent). Thirty-five (23 per cent) of these now require some supplemental thyroid therapy.

The effect of different dosages is analyzed. Eighty-eight patients (56 per cent) responded satisfactorily to a single dose of I^{131}, averaging 0.2 millicurie per gram of estimated thyroid tissue. An additional 21 per cent responded satisfactorily to two doses. Eleven patients (6 per cent) required three or more doses. Patients with nodular and postoperative goiters were more resistant to this therapy but responded if a sufficient amount of I^{131} was given. The diffuse goiters were usually reduced to normal size; the nodular goiters were not.

In general, the authors feel that I^{131} therapy is sound, constituting a valuable addition to the armamentarium in the treatment of hyperthyroidism in a hospital which possesses adequate technical assistance and physical equipment. With greater clinical experience and the improvement in physical methods a more accurate determination of optimal dose should be possible—*James G. Snead, M.D.*

Dobyns, Brown M., and Maloof, Farahe. The study and treatment of 119 cases of carcinoma of the thyroid with radioactive iodine. *J. Clin. Enodcrinol.*, Nov., 1951, *11*, 1323–1360.

The authors have reviewed 119 cases of carcinoma of the thyroid seen at the Massachusetts General Hospital during the past six years. They again show that follicular adenocarcinomas which contain thyroid usually take up radioactive iodine while the highly anaplastic carcinomas do not. However, it is noted that even in the follicular adenocarcinomas, the initial uptake was only 0.6 per cent of the dose per gram of tissue. Thus, the best uptake is decidedly less than that of normal thyroid tissue. They also show that there is no strict correlation between the histopathological patterns of the tumors and the radioactive iodine uptake.

Sixty patients in this series were subjected to total thyroidectomy as operation not only removes the competition for radioiodine between normal thyroid tissue and metastases, but also may induce metastases to develop the ability to produce thyroid hormone. This procedure has either initiated or increased the ability to collect radioiodine in 11 of 13 cases of follicular adenocarcinomas and 4 of 5 cases of mixed follicular and papillary carcinoma. Thus, the procedure was of striking therapeutic value. In none of the anaplastic carcinomas was the uptake sufficient to be of therapeutic significances. A demonstrable increase in radioiodine uptake was usually elicited within three to fourteen days following thyroidectomy. However, in several cases it was as long as six months. Treatment was most effective in those patients in whom the initial tumor uptake showed a prompt increase following thyroidectomy. The question as to whether thyroidectomy cases increased rate of growth in metastatic lesions has been debated. Generally speaking, functioning metastases which tend to grow following thyroidectomy are those most effectively treated with radioiodine.

The authors point out that the destruction of function of normal thyroid with radioiodine has certain disadvantages. The large doses of I^{131} required lead to considerable total body irradiation. The incompleteness of lethal effect of a first dose may necessitate additional therapy. Valuable time is lost during this period of irradiation and during the period required for the radioiodine to disappear in order that a repeat uptake can be done to prove total destruction. Also, if multiple doses are required the time is further increased.

Ten patients were given thiouracil compounds in an effort to induce or increase the uptake of the metastases. The authors demonstrate that medical antithyroid therapy was of greatest benefit in those cases which had some uptake in the metastases previous to medication. They also feel that a massive dose of radioiodine administered after a high uptake has been elicited is preferable to giving many frequent small doses over a long period of time. They show that repeated small doses may destroy the functioning capacity of the tumor cells and still not be lethal to them.

The most serious side effects from irradiation with radioiodine occur in the hematopoietic system. A decline in the actual number of the lymphocytes in the peripheral blood is the most likely change.—*K. R. Kaess, M.D.*

Miller, Earl R., and Sheline, Glenn E. Studies with radioiodine. III. Problem of dosage in the treatment of hyperthyroidism. *Radiology*, Nov., 1951, *57*, 720–728.

In the treatment of hyperthyroidism with I^{131} it would be useful if the quantity of radiation to which the thyroid gland is subjected could be designated in terms of the amount of ionization produced. This paper represents an attempt to place I^{131} therapy for hyperthyroidism on a radiation-delivered basis.

Only patients with definite hyperthyroidism were studied. A test dose of I^{131} (100 microcuries or less) was given to the patient, the thyroid uptake curve was determined, the thyroid weight estimated, and the amount of I^{131} necessary to give the predetermined dose calculated. It was found that the "preselected" radiation dose, as calculated from the test dose uptake curve, frequently differed from the "actual" radiation dose, as calculated from the uptake curve of the therapeutic dose. These differences were dependent upon changes in effective half-life and maximum uptake between test dose and therapeutic dose. Since the dose of radiation to the thyroid is dependent on the effective half-life, it is necessary to determine the effective half-life for each patient when the authors' method of dose calculation is used.

A study of the results of treatment of hyperthyroidism with I^{131}, with the dose expressed in terms of microcuries per estimated gram of thyroid, showed that some remissions were achieved, and that no hypothyroidism was produced, by initial doses of 90 to 129 microcuries per gram. Treatment has accordingly been started with 120 microcuries per gram of thyroid as an initial dose. Subsequent doses of radioiodine are administered if necessary, their size being based on the response of the patient to the first dose.

Necessary calculation and formulas for determination of radiation dosage to thyroid tissue in terms of the beta-roentgen equivalent physical unit (B-rep) are given.—*A. W. Sommer, M.D.*